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THE MONTHLY BULLETIN OF THE DIVISION OF ZOOLOGY FOR MAY, 1906.

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Preface to Volume IV.

This is the first Number of the Monthly Bulletins that are designed to constitute Volume IV of the Monthly Bulletin of the Division of Zoology of the Pennsylvanian State Department of Agriculture. (The Zoological Quarterly Bulletin ceased with Volume III, Number 1, May 15, 1905). The efforts of the Economic Zoologist are directed toward making these Bulletins plain, readable and practical, and thoroughly reliable in every regard, without being either too technical or scientific for the practical citizens, nor too elementary for the use of students of Nature. We are trying to bring the Bulletins to a higher educational standpoint as the readers study them and increase in their understanding of the subjects to which they pertain. Volume III is to be compared with a Primer in practical Economic Zoology, while we hope to make Vol. IV at least a First Reader or a grade in advance.

In this Volume we desire to make a special feature of the diagnosis or effects of the various kinds of insects causing injury to plants, upon the basis of symptoms or evidences of their work, rather than to describe the insect itself. This is a practically new undertaking, and demands a great deal of careful observation and extensive study upon the part of the Economic Zoologist. Those persons who have not studied Entomology sufficiently to know the scarcity of literature upon this particular feature of the subject will not comprehend the task that is before us, and may not be able to make due allowance for such imperfections as must result from being forced to work over this ground for the first time. It is an easy matter to describe insects attacking plants and to give the remedies for them. These descriptions and discussions of treatments are to be found in nearly all publications upon such subjects and they vary but slightly. However, many persons never see the various insects that cause injuries to their property, and observe only the symptoms or results of their attacks. If we can succeed in describing these results in such a manner that the readers can understand from them what insect has been causing injury, they will be able to refer to the discussion of this particular insect in Volume III and there find its remedy outlined.

For the task which we have assigned to ourselves for this year we need the help and co-operation of all interested persons in making observations and sending us detailed notes, and also specimens, not only of the insects, but especially of the work done by them. Parts of plants that are liable to wilt or be crushed should be enclosed in small tin boxes, and insects should be sent in such a way that they will not be crushed in the mail. Notes should include information concerning the food and habits of the insects in question, the dates of their first appearance and final disappearance, their enemies, places and methods of concealment and whatever remedies have been tried, with the results, whether successful or not. While this office is able to give the standard remedies of nearly all insects, occasionally certain species may occur in injurious numbers, which have been successfully treated by original methods in the neighborhood of their outbreak. Of these we wish especially to learn in order to add the results of the experiments of our readers to our own.

All practical persons are also requested to give us accounts of the results of applications of such remedies as we have advocated, either in the Bulletins or by letters, stating when and how the insecticides were applied, upon what kinds of plants, and for what insects, and particularly describing the results. We know that it is possible for our trained scientific assistants to obtain certain results with some kind of insecticide, and the practical citizens to have different results with the same material. It is important for this office to know exactly what has been achieved with the various remedies which we have suggested.

During the coming year we shall have at least ten inspectors constantly at work in this State, devoting their time to making inspections for injurious insects of various kinds, but particularly for the San José Scale. Persons needing help in controlling pests of any kind should write to this office at the earliest possible date and send specimens and, if possible, parts of the plants attacked. Whenever the inquiry can be answered by our sending marked copies of our Bulletins instead of writing letters, that must be our method of reply, but all communications received will be asknowledged, either by personal letter or by a marked Bulletin.

The investigations of the Reptiles and Amphibians, or Serpents, Lizards, Turtles, Frogs, Toads and Salamanders in this State are being continued, and about the middle of the summer we hope to publish a preliminary Bulletin upon this subject, and urge our readers to send us all possible specimens, in order that we may study them. Transportation charges will be paid by us, and copy of the Bulletin upon such subjects will be sent to each person sending

us one or more specimens. It is not difficult for persons who know of snakes being killed in their region to procure them and send them to us by express, even though they be mutilated in killing. This will greatly help the studies we are trying to make. Specimens that are reported as rare or curious should be procured, even though by considerable effort, at once, and sent to us as soon as possible by express, at our expense, or by mail when postage will be refunded.

Bulletins will be sent free to all now on our mailing list, and other names will be added as received. None have been dropped without three notifications, and we hope to avoid the necessity of a revision before the next session of the Legislature can permit the printing of a sufficient number to meet the demands of all.

CORRECTION: THE PAPER PUBLISHED AT HAZLETON, PA., WHICH SO UNJUSTLY ATTACKED THE ZOOLOGIST FOR PUBLISHING BULLETINS ON BIRDS, HAS CHANGED HANDS, AND IS EDITED BY MR. GEORGE MAUE, TO WHOM THE COMMUNICATIONS OF PROTEST SHOULD BE SENT, AND NOT BY MR. C. B. SNYDER, AS GIVEN IN THE NEWSPAPER DIRECTORY. WE ARE PLEASED TO LEARN THAT THE LATTER HAS BEEN A FAITHFUL SUPPORTER OF OUR EFFORTS TO DO SOMETHING FOR THE PERSONS WHO NEED HONEST HELP, WHICH WE TRY TO GIVE.

H. A. SURFACE,
Economic Zoologist.
Harrisburg, Pa.

REPORT OF PERSONAL EXPERIMENTS.

Experiments with Asparagus Beetle (*Crioceris asparagi*).

The Asparagus Beetle is becoming so generally introduced into the State of Pennsylvania, and its attacks are becoming so serious to this important vegetable crop, and it is so easily controlled, that we find it very important to here publish something concerning its habits and the remedies.

This beetle was introduced from Europe, and is now found attacking asparagus in many portions of Pennsylvania, but not in all. However, it is gradually spreading over the State, and because it is a comparatively new pest, many asparagus growers of this State do not know what to do for it. A brief description of this beetle in its various stages and an outline of its habits and life history are helpful to persons who need to fight it.

The Egg.

The egg of the Asparagus Beetle is a dark-colored elongate object, standing on end on the asparagus stalk or some of its branches. These eggs are generally placed in rows, varying from a few to several in a row, and may occur at any time from the latter part of May to August. In this State there are certainly two broods of this pest per year, and these have a tendency to overlap one another to some extent.

The Larva.

The larva of this Beetle is a dark green, moist, coiled "worm," looking very much like a young sawfly, or the larva of such insects as those that feed upon the leaves of raspberries, currants and gooseberries, certain willow trees, etc. It is generally found upon the branches of the asparagus plant, and feeds very abundantly upon the leaves or tender shoots where it clings both by partially curling its posterior part around the branch, and also by its moist and sticky or adhesive body. Owing to the fact that in this State it is constantly moist and exposed, it is easily killed by a great number of contact insecticides, such as pulverized fresh lime or pyrethrum and flour, or lime-sulphur and tobacco dust mixed together, and dusted over it, as for Rose Bugs and Currant Worms;

and owing to its feeding habits, chewing the tissues of the plant, it is also easily killed by internal poisons or arsenites, such as Paris Green and Arsenate of Lead applied as dilute dusts or sprays, although these substances cannot be used upon Asparagus Beetles where the plants are to be cut for food, unless they always be cut when very low or just peeping through the ground.

The Pupa.

The pupal or third stage of the Asparagus Beetle is spent just beneath the surface of the ground, where the white mummy is to be found resting and where it undergoes its transformation into the form of the beautiful red and white spotted beetle, assuming the winged stage. Owing to the fact that it pupates in cells in the ground, it is possible to destroy it in this stage by stirring the soil thoroughly at the time it is thus covered, as breaking up its pupal cells should kill it.

The Imago.

The Imago or beetle of the Asparagus Beetle is a beautiful red, white and dark green beetle about one-fourth of an inch long and rather slender, being one-half as wide as long. It belongs to the Chrysomellidæ or "Leaf-eating Insects," and is to be found at this time of year near the asparagus patch or field if the observer knows where to look for it. In the winter of 1902 we discovered that the pests winter in the adult or beetle stage in hollow wood of asparagus stalks and in old hollow raspberry canes, and such other places as it can find concealment and protection. This was an original discovery, which has not been published, and leads directly to one of the important steps in controlling this pest. This method consists in burning all possible rubbish in and around the garden or asparagus field or patch in the early spring before the Asparagus Beetle comes forth, which may be about the middle of May or a little later, owing to the locality and seasonable conditions.

The adult beetle is not to be killed by the contact remedies mentioned above for the larva, but since it feeds on the green parts of the asparagus it can be destroyed by arsenical poisons. The best possible measure where this pest is abundant is to leave a few stalks at the one side of the asparagus patch, let them grow and branch freely and let the beetles lay their eggs upon them very extensively, and then after the larvæ become about one-half grown, either cut and burn the plants or spray them with some strong arsenical insecticide, such as those mentioned below, or with some of the dust materials mentioned under the remedies for larva above. However, it is not best to cut young asparagus plants, and for those too

young some contact sprays are necessary. During this coming season we shall experiment with dusting versus spraying with liquids, but last season we had opportunity to make some careful experiments with the assistance of Mr. D. K. McMillan, one of our field agents, and the results of these are tabulated below:

Kind of Remedy Applied.	Formula or percentage.	Number treated.	Effects on Pests—per cent. killed.
1. Paris Green and Lime,	½ oz. P. G., 1 oz. Lime. 3 gal. Water.	50	50 per cent.
2. Paris Green and Lime,	1 oz. P. G., 2 oz. Lime. 3 gal. Water.	50	50 per cent.
3. Paris Green and Lime,	1 oz. P. G., 3 gal. Water.	50	30 per cent.
4. Lead Arsenate,	1 oz. Ld. Ar., 1 gal. Water.	50	90 per cent.
5. Lead Arsenate,	2 oz. Ld. Ar., 1 gal. Water.	50	90 per cent.
6. Lead Arsenate and Resin Soap,	2 oz. Ld. Ar., 5 oz. R. Sp. 3 gal. Water.	50	100 per cent.
7. Paris Green, Lime and Resin Soap,	½ oz. P. G., 1 oz. Lime. 1 oz. R. Sp. 3 gal. Water.	.....	.....
8. Lead Arsenate and Whale Oil Soap,	2 oz. Ld. Ar., 5 oz. Wh. Sp. 3 gal. Water.	50	90 per cent.
9. Lead Arsenate and Whale Oil Soap,	2 oz. L. Ar., 8 oz. Wh. Sp. 3 gal. Water.	50	95 per cent.

These experiments were performed during the first week of June, 1905, when the weather was warm and fair, and in no case was there any injurious effect whatever shown upon the plants. These were about eighteen inches high and in the second year of growth. The materials used were in all cases mixed in the field and took but a few minutes to prepare each, and the cost of the same was so slight, both for labor and material as to be very unimportant, ranging from one-half cent to one cent per gallon.

At the time of treatment the plants were very badly infested with larvæ, mostly about one-half grown, but varying in ages, and there were also some adult beetles present. On Nos. 1, 2 and 3 the material did not adhere well, and its lack of adhesiveness is probably the cause of the low percentage of pests killed on these rows. The Resin Soap is that which is made by James Good, of Philadelphia, for the purpose of making material used as insecticide or fungicide

adhere somewhat better to smooth plants, and it was very effective for this purpose. The poison was added to it, as it alone did not do the killing.

The experiment also showed that Whale Oil Soap alone was not as good an adhesive substance as the Resin Soap, and that Lead Arsenate sticks better to such hard smooth plants than does Paris Green.

When the experiments were performed it was certain that complete destruction was imminent, and this was proven by the check, No. 10, which was entirely denuded of its foliage by the insects, which were left upon it to compare results with the other sprayed rows.

The apparatus used was a simple hand sprayer, and as the work was not especially laborious these experiments prove conclusively that no one need to be alarmed about the methods of controlling this pest upon asparagus that must be permitted to grow. The Lead Arsenate, 2 oz.; Resin Soap, 5 oz.; water, 3 gals., killed all of the pests and left no evil effects. Of course, this is a dangerous poison, and can not be applied to plants that are to be eaten, but it is not necessary to spray such plants.

FORMULÆ AND METHODS FOR TREATING INSECT PESTS AND PLANT DISEASES.

A. FUNGICIDES, FOR PREVENTING DISEASES OF PLANTS.

A fungicide is a preparation for preventing diseases of plants. As most of these diseases are due to fungi, these materials are consequetly called fungicides. The following formulæ are not insecticides and should be used only for diseases for which they are recommended, and not for insects. It is essential for all fungicides to be applied a week or two before the time for the first evidence of the disease to appear. Many of them can be made to act as both fungicides and insecticides by the addition of the proper material (See I. C., "Combined Insecticides and Fungicides.").

1. Ammoniacal Solution of Copper Carbonate, or Cupram.

Formula: Copper Carbonate, 5 ounces; Ammonia (26° Beaumé), 3 pints; water, 45 gallons.

Dissolve the Copper Carbonate in the ammonia. This may be kept any length of time concentrated in a stoppered bottle, and diluted to the required strength when ready for use. The prepared dilute mixture loses strength on standing open.

This fungicide is used in place of the Bordeaux Mixture when there is objection to the slight staining. Bordeaux Mixture is the common and the best practical fungicide where the operator does not object to the stain, as in all cases excepting ornamental foliage of plants and ripening of fruits or vegetables ready for the market. However, after the fruit becomes nearly grown, the Bordeaux Mixture may stain or discolor and may also produce disfigurements, such as "russeting" of the apple, etc. It is at this period, therefore, that the above fungicide is used. The Ammoniacal Copper Carbonate can be used without any danger of discoloring.

2. Bordeaux Mixture.

For use as a liquid spray there are several formulæ for this very important fungicide, but the principle of making is the same in each.

Make a stock solution of Copper Sulphate (Blue Vitriol) by suspending it in a bag just below the surface of a vessel of water, or dissolving it in hot water, in proportion of one pound to a gallon of water. Do not put it in a metal vessel. Slake also a dilute solution of lime; use a quantity of good lime, slake slowly, and add water to make a thick milk of lime; allow to cool before using, and always keep the lime covered with water.

The operator should either use fresh lime and slake it with water and thus obtain the calcium hydrate, or make a stock solution of lime paste by slaking the lime dry in the ordinary manner, and at once add enough water to cover it, keeping it in a barrel or vat and of the consistency of paste or putty at any time. Dip this out and use three times as much (by weight) as unslaked lime, being careful that it is kept covered with water to exclude the air. Air-slaked lime, which is the carbonate of lime, can not be used in any of the following formulæ where the lime is to enter into a liquid, unless twice as much be taken as would be required in using the water-slaked.

(a) For dormant trees use: Copper Sulphate, 6 pounds; Lime, 6 pounds; water, 50 gallons. (The lime may be reduced in this.)

(b) For most plants in foliage use: Copper Sulphate, 4 pounds; Lime, 4 or 5 pounds; water, 50 gallons.

(c) For delicate plants use: Copper Sulphate, 3 pounds; Lime, 6 pounds; water, 50 gallons.

If the lime be of good quality and the mixture be made as directed, there will be no burning of the foliage. However, it is always best to determine whether enough lime has been used by testing the mixture.

"There are three simple tests which may be used. (1) Hold a clean, bright knife blade in the Bordeaux Mixture for at least one minute. If it become copper-plated more lime should be used. (2) Pour some of the Bordeaux Mixture into a shallow dish and, holding is up to the light, blow gently across its surface. If properly made a thin pellicle or 'scum' will form on the surface of the liquid. If this does not form more lime should be added. (3) Dissolve one ounce of ferro-cyanide of potassium in 5 or 6 ounces of water. Pour some of the Bordeaux Mixture into a white dish and add to it a few drops of the ferro-cyanide solution. If sufficient lime has been used no change will be noticed. If a brownish-red discoloration takes place more lime should be added."

3. Soda Bordeaux Mixture.

Copper Sulphate, 4 pounds; Commercial Caustic Soda or Soda Lye (sodium hydroxid), slightly in excess so that the mixture is alkaline—according to strength, about 1 pound and 5 ounces by testing; water to make 50 gallons.

To use instead of ammoniacal copper carbonate, to act as a fungicide and leave no stain.

Warning.—In each case of change of grade or brand of commercial caustic soda it will be necessary to test the strength with litmus paper to keep a slight excess of soda or lye, as shown by turning red litmus blue. Keep the mixture well agitated.

To Keep Caustic Soda.—After opening a container and testing, weigh out the entire contents into portions such as are needed to make a single spray tank of mixture; put in Mason jars under shelter, cover with a pint or so of water, and this portion is ready to be used as needed. Opened packages of caustic soda will absorb water and increase in weight on standing; unopened packages will usually keep for a year or more.

4. Corrosive Sublimate.

Corrosive Sublimate is deadly poison to all animal life, and therefore care must be taken to prevent animals from eating the materials treated. It is used against potato scab and grain smuts. (See also Formalin.)

For use, dissolve two ounces of corrosive sublimate in two gallons of hot water; then dilute to 15 gallons; allow to stand 5 or 6 hours, agitating several times meanwhile. (Always use wooden or earthen vessels; never metallic.)

(a) For Potato Scab.—Place the seed potatoes in a sack and immerse in this solution for 1 or 2 hours. Plant them before they become contaminated with stray spores of the scab that may be found on dirty floors of the barn, etc.

(b) For Smuts of Oats, Barley and Wheat.—The seed may either be soaked, as for potatoes, or may be sprayed thoroughly with the solution. In either case the seed must not be kept wet long enough to heat. Oats should be enclosed in sacks so they can be immersed in the liquid, as otherwise they float.

5. Formalin.

This has been found to be the best remedy for potato scab and smuts.

(a) For Potato Scab.—Soak the seed potatoes for two hours in a solution of a one-half pint of formalin to 15 gallons of water.

(b) For Grain Smuts.—Soak the seed one to two hours in a solution of 1 pound of formalin to 50 gallons of water, or pour or spray the liquid over the seed while shoveling it over on a floor to mix it. Put oats into sacks to immerse.

(c) For Onion Smut and Black Rot of Cabbage.—Soak the seed for one to two hours in a solution of one-half ounce Formalin to 1 gallon of water, then plant in uncontaminated soil.

6. Potassium Sulfid.

A stock solution is made as follows:

(a) Formula: Potash, 32 pounds; sulphur, finely ground, 37 pounds; salt, 2 pounds; water, 50 gallons.

The potash, sulphur and salt may be mixed together in a large metal tub with a little water; the chemical action will make it boil. For spraying on foliage dilute with 100 times as much water. It

is used against the active stages of the red spider. Three applications at intervals of one week kills the eggs and moulting forms.

(b) A solution, which loses strength upon standing, is made by mixing one-half to one ounce potassium sulfid (Liver of Sulphur) in one gallon of water. It is used against mildews of gooseberry, rose, etc.

7. Dust Spray.

Sulphate of Copper, Dehydrated or Powdered (Dry), 1 pound; Finely divided Dust, such as Slaked Lime or Flour, 20 pounds; dust this over the plants when the leaves are moist, as with dew, or after a rain. When they are moist with dew in the evening or in the morning is a good time. (See No. 61.)

8. Lime-sulphur-salt Formula (No. 35). All preparations given of Lime sulphur Formulæ are first class fungicides, especially for Peach-leaf Curl when applied before the buds burst and probably for most other fungous diseases applied safely as a spray on the foliage when dilute with twice the amount of water of No. 35.

9. Sulphur and Lime.

Powdered Sulphur, 1 part; Lime, 20 to 40 parts.

Mixed in the soil in hills or furrows where cabbage is to be set to prevent Club Root, and where Sweet Potato plants are set this mixture is said to prevent Sweet Potato Rot.

10. Cut and Burn Diseased Parts.

Some plant diseases can not be met by any other means known at present than by cutting out and burning the diseased parts. Among these are Black Knot of Plum and Cherry, Pear Blight, and related diseases which are thought by many to be identical.

B. INSECTICIDES FOR KILLING INSECTS.

Internal Insecticides, for Poisoning Chewing Insects.

11. Paris Green.

Arsenical insecticides are used to combat the various insects that eat the foliage and fruit. Although there are several better arsenical insecticides, Paris Green is the most popular. Even the Paris Green from the best manufacturers contains at times a great deal of uncombined arsenic. Therefore, it is to be expected that some persons get better results than others in its use. Some will have the foliage burned very badly and others not at all. This material is so likely to be adulterated in this State that it is advisable for purchasers to obtain a guarantee of purity directly from the manufacturer. There is no reason why Paris Green should not be as

effective as it was a few years ago, excepting that it is now often adulterated. In one of the neighboring States a great many samples of Paris Green were analyzed, and none that were purchased from the manufacturers were found adulterated, while several from dealers were so adulterated and diluted as to be ineffective when used according to standard formulæ.

To make a liquid spray of Paris Green, slake the lime gradually and sprinkle in the Paris Green, then add the rest of the water; or stir the Paris Green into the paste with enough water to make it pasty or mushy, in a smaller vessel, and then rinse it into the larger vessel containing the water. Always use at least twice as much lime as Paris Green in order to destroy the evil effects of the free acid that would burn the foliage.

(a) Strong Formula: Paris Green, 1 pound; Water, 75 to 100 gal.

This is for very hardy plants, such as potatoes, and for insects that are especially hard to kill, such as Canker Worms.

(b) Medium or Ordinary Formula.

Paris Green, 1 pound; Fresh lime, 2 to 4 pounds; Water, 150 gal.

This is the formula most generally used for nearly all plants, but for the tender kinds, it should be yet more dilute.

(c) Dilute formula for tender plants.

Paris Green, 1 pound; Fresh Lime, 2 to 4 pounds; Water, 200 to 300 gallons.

This is for such plants as the tender varieties of plums, like the Japanese, and also for peach, apricot, etc. It is not necessary to apply this or any other insecticide excepting when insects are present, or are likely to appear soon. There have never been any ascertained examples of persons being poisoned by the use of fruits or vegetables sprayed with arsenites, although it would not be best to spray shortly before picking or gathering the crop.

12. London Purple.

This is a common arsenical insecticide, although not used as much as formerly. It is a waste product in aniline dye manufacture. It is cheaper than Paris Green and is held in suspension in water longer, but the composition is very variable and more of the arsenic is in a soluble form than in Paris Green, therefore it is more dangerous to foliage, and is not highly recommended.

When used with three or four times as much lime it will be safe, and can be used in practically the same proportions as Paris Green.

13. White Arsenic.

Owing to the great amount of free acid which White Arsenic contains it can not be used alone upon foliage plants, but it is a valuable poison when mixed with flour or powdered sugar, or both, for

certain insects like cockroaches, or for sprinkling on slices of potatoes for making poison bait traps.

White arsenic, 1 part; flour, 20 parts; powdered sugar, 20 parts.

14. Arsenate of Lead or Disparene.

This is the least soluble of all the arsenical insecticides, and is, therefore, not liable to burn the foliage, even if used in large proportions. It is also quite adhesive, and is about the only arsenical poison that will stick to smooth plants without the addition of an adherent (See I. D., No. 62, etc.).

Formula: Dissolve 11 ounces acetate of lead (sugar of lead) in 4 quarts of water in a wooden pail, and 4 ounces arsenate of soda (50 per cent. purity) in 2 quarts of water in another wooden pail. (The sugar of lead can be dissolved more quickly by using warm water.)

The above solutions poured into 150 gallons of water as required for Codling Moth, Tent Caterpillars, etc.; while these solutions poured into only 25 gallons of water are required for the Elm Leaf Beetle.

Arsenate of Lead may be used whenever Paris Green is recommended. If only a small quantity of the arsenate of lead is required it can be purchased in the prepared paste form. Its trade name is "Disparene."

15. Arsenite of Lime.

Formula: White Arsenic, 1 pound; Freshly burned lime, 2 pounds; water, 1 gallon.

Boil together for 45 minutes, or until clear. Keep the resulting product in a tight vessel.

One quart of this added to a barrel of water or Bordeaux Mixture is used against biting insects. However, in Oregon, as well as in other States, it very often burns the foliage.

16. Arsenite of Soda.

(Known as "Kedzie" formula.)

Boil 2 pounds of white arsenic and 8 pounds of sal soda for fifteen minutes in 2 gallons of rain water. Put this in a jug and label "Poison." When ready to spray slake 2 pounds of lime and stir it into 40 gallons of water, adding a pint of the mixture from the jug.

The arsenic in a pint of this mixture is equivalent to 4 ounces of Paris Green, and may be used whenever Paris Green is recommended. This insecticide is used in preference to Arsenite of Lime, because in the Arsenite of Soda one is sure of all the arsenic being combined to become insoluble in water, and thus there is no danger of burning the foliage. Arsenite of Lime is cheaper, but Arsenite of Soda is more reliable.

17. Green Arsenoid and Green Arsenite.

These insecticides are applied in the same manner as Paris Green. They contain no free acid, and are thus not so liable to burn the foliage. They cost less than Paris Green (12c to 15c per pound), and being finer remain in suspension longer. Dr. Marlatt, of the Division of Entomology, U. S. Department of Agriculture, says Green Arsenoid should replace Paris Green as an insecticide.

Avoid Paragrene, Scheele's Green, White Arsenoid, (Barium Arsenite), and "Bug Death." All but the last named contain so much soluble acid as to injure the foliage, and the last is reported as worthless by experiment stations that have tested it, and our own experiments have proven this true.

18. Poison Traps.

(a) Fresh Baits. These are prepared by dipping slices of potatoes, apples, or bunches of damp or wet clover into solutions of arsenical poisons, or dusting them while wet with arsenical poisons and placing them around the plants to be protected, as for Climbing Cutworms, or just beneath the surface of the soil around the plants, as for Common Cutworms and Wire Worms, or beneath boards in gardens where Cutworms and Wire Worms occur.

(b) Bran mash.

Arsenic Formula: White Arsenic, 1 pound; Brown Sugar, 1 to 2 pounds; Bran, 10 pounds.

Mix thoroughly and then add water to make a wet, but not sloppy mash. Other arsenites may be used if White Arsenic cannot be obtained. Make the proportion of the poison according to the kind used.

It used against Cutworms working in garden crops, at the rate of one teaspoonful at the base of each plant. It is also recommended to be put at evening in rows of corn where Cutworms and Wire Worms, Grasshoppers or Crickets are likely to be numerous, and especially in furrows where corn is to be planted. With tender plants care should be taken lest heavy rains wash the poison against the stems and thus burn the plants.

(c) Criddle Mixture.

This mixture has met with great success in some places as a remedy against grasshoppers.

Formula: Paris Green, 1 part; Salt, 2 parts; Horse Manure, 100 parts (by measure).

Mix the Paris Green with the water; mix this through the horse manure and then add enough water to make a soft but not sloppy mash. If the horse manure be fresh the addition of the salt is not necessary. Use as the Bran Mash, i. e., simply scatter the mixture

over the land where the "hoppers" are thickest. It is most effective when spread in hot, sunny weather.

(d) For Household Pests.

Borax, white arsenic, powdered sugar and flour, equal parts are recommended for cockroaches, and a small quantity of white arsenic baked with cake dough makes a very good "home-made" rat biscuit, which has been known to be successful. This should be guarded with care from being used accidentally as food.

19. Borax.

For cockroaches spread powdered borax on bread, sweet potatoes or banana peelings, or mix with sweetened chocolate and place the bait where the roaches can get it. See Turpentine, etc. Use borax freely about sink, wainscoting, etc.

20. Plaster of Paris.

Plaster of Paris, 1 part; Powdered Sugar, 1 or 2 parts.

This has been used as an internal insecticide for cockroaches especially. The insects are said to eat the mixture, which will form an insoluble and undigestible mass in their digestive tracts and thus kill them. It is also said to kill mice and rats, but we have not been able to give it a test before this writing.

21. Hellebore.

This is an internal poison for insects, but not for man. It is used in place of Paris Green on such plants as celery, cauliflower or cabbage when there is danger from poison remaining on the part to be eaten. Hellebore is not poisonous to man, and so can be handled with impunity.

For Currant Worms—Sprinkle the dry hellebore on the leaves, on the under side when possible, when the dew is on, or after the leaves have been sprinkled with water, to insure its sticking.

Hellebore may be made into a decoction by using 1 ounce in from 1 to 3 gallons of water and applying it as a spray to poison insects where arsenites would be objectionable, as upon leaves to be eaten or on ripening fruits, and especially upon currants and gooseberries.

One part can be mixed with 5 to 10 parts of a cheap grade of flour and kept over night in a closed vessel, when all will be equally efficient as a powder.

CONTACT APPLICATIONS, FOR KILLING SUCKING INSECTS.

The contact insecticides are chiefly for the suctorial insects, because these can not eat the internal poisons and consequently can not be killed by them, although the insecticides mentioned in this group will also kill most biting or chewing insects with which they

come in contact. It is necessary for the contact insecticide to touch the insect, and if the latter be so protected, as by curled leaves or otherwise, that it is not touched by the application, the same is useless. For this reason it becomes necessary to apply such materials early, before the leaves become large, abundant, or deformed.

22. Kerosene.

Pure kerosene, if properly applied, can be used on pear trees in winter without great danger to the trees, but 40 per cent. kerosene is almost as destructive to insects, and can be used on apple and pear trees in winter without great danger. Under no circumstances, however, is pure kerosene recommended to be used on active plant life of any kind. It has been used undiluted on plants dormant and in foliage (apple, pear and others) without apparent injury, but there are too many uncertainties attending its use to warrant its recommendation.

For pure sprays always purchase the 150 degree fire test kerosene.

For Cockroaches and other Household Pests.—With an atomizer spray into the cracks, etc., where the roaches are located.

For Mosquitoes.—Kill the larvae or wriggers in water by putting one tablespoonful of kerosene on each square yard of water area.

23. Kerosene Emulsion.

This is the best form into which kerosene can be put in order to obtain the best results. When the kerosene is in an emulsion the proportion of kerosene is known to a certainty, while with the Kero-water sprays the proportions is not always just what one expects.

A stock emulsion is made as follows:

(a) Soap Emulsion.

Hard Soap, shaved fine, one-half pound; Kerosene, 2 gallons; Water, 1 gallon.

Dissolve the soap in boiling water; remove from the stove and add the kerosene while the water is still boiling hot; churn with a spray-pump until it gets to a soft-butter-like mass. Keep this for a stock solution. It is, of course, 66 2-3 per cent. kerosene.

For Plant Lice and Young Scale insects use 1 part of the stock solution to 8 parts of water. Some insects will require a stronger mixture.

(b) Milk Emulsion.

When a small quantity of emulsion is wanted it is often less trouble to make it with sour milk than with the soap and water.

Sour Milk, 1 gallon; Kerosene, 2 gallons. Beat well.

Dilute as in preceding. If the milk be sweet add a little vinegar.

(c) Kerosene Emulsion with Pyrethum Sulphur, etc.

The insecticidal value of Kerosene Emulsion made by either of

the above formulæ is increased by the addition of Pyrethrum, Hellebore, Tobacco, Sulphur, or any other powdered contact insecticide. It is particularly more valuable against Red Mites or Spiders when an ounce of powdered sulphur is added to each gallon of the material used as a spray.

24. Kerosene Mixture.

By using a Kero-Water Spray Pump or other spray pump made for the purpose of mixing kerosene and water at the time of spraying, a very good substitute for Kerosene Emulsion is obtained with no further trouble than to place the kerosene in one vessel and water with which it is to be mixed in another. It is to be applied according to one of the two general formulæ, as follows:

(a) Strong, for dormant trees.

Apple and pear may not be injured with Kerosene Mixture as strong as 50 per cent., while plum is likely to be injured if it be stronger than 40 per cent., and peach, even though dormant, with more than 25 per cent. Thirty-five per cent. Kerosene Mixture is about the weakest that will kill the scale during the dormant season.

(b) Dilute, for plants in leaf:

Kerosene, 1 part; Water, 10 parts.

This will not injure the foliage of any fruit trees or garden plants if properly applied, but is as strong as should be given to peach. All injuries by oils will decrease by spraying upon a bright and breezy day when the evaporation is hastened.

Experiments seem to indicate that, like crude petroleum, the safest time to apply is on a bright, windy day in early spring, just before the buds begin to swell, in the form of a very fine spray.

One part of kerosene to six parts of water can be used on many trees in foliage without injury, while plant lice are killed in a mixture as weak as 1 part of kerosene to 15 or 20 parts of water. For plant lice, therefore, 1 part kerosene to 10 of water is probably the best proportion to use. This proportion will also kill young scale insects, and is a good summer spray for San José Scale.

25. Benzine, Gasolene and Turpentine.

These substances are used singly and undilute, as contact insecticides, where pests are not on green leaves or plants that would be injured.

They are especially valuable to spray or inject into cracks inhabited by cockroaches, bed bugs, flea larvæ, carpet beetles, etc., and will kill all insects with which they come into contact, which injure carpets, clothes, or other fabrics. To kill ants find their nest and pour one of these substances into it in abundance.

We have examined an insecticide sold in this State and recom-

mended to kill household pests of all kinds, scale insects, etc., and have found it to be nothing but benzine colored pink with a red vegetable extract, such as juice from red cabbage or beets.

26. Carbolic Soap.

Soft Soap; Rain water, to thin like paint; Carbolic Acid (crude), 1 ounce. Apply to the bark of trees, twigs, etc., but not on the leaves.

There is a commercial carbolic soap that is not so strong, and is recommended for scrubbing pet animals and live stock for parasites, such as lice, fleas, etc.

27. Carbon Bisulphide, or Bisulphide of Carbon. ("High Life.")

(a) For Insects in the Air.

This substance is used against a number of insects, and also other animals, which cannot be combated with internal or even contact poisons. This liquid volatilizes very rapidly, and the gas being heavier than air, must be generated from above. It is used with good success against ants, buffalo or carpet beetles, clothes moths, museum pests, grain insects, woodchucks, prairie dogs, etc.

For the Buffalo Beetle.—A very strong percentage of the Carbon Bisulphide must be used to enable the fumes to penetrate into the body of the rugs, carpets, etc., where the insects are.

For Insects in Stored Grain.—Use one pound of Carbon Bisulphide to each 1,000 cubic ft. open space, or 100 bu. grain. Place the liquid in a shallow dish on the top of the grain; close the bin tightly and leave for twenty-four hours.

CAUTION: Keep fires of all kinds away where using.

For Borers in Trees.—Inject a few drops of this liquid into their holes, and plug them with mud, putty, or grafting wax.

(b) For Insects in the Soil.

For Ants.—First find the ant hill, then with a cane make several holes ten to twelve inches deep, into each of which pour 3 to 5 tablespoonfuls of Carbon Bisulphide. Cover the ant hill with an old blanket or burlap, wet, to keep in the fumes, and leave twenty-four hours. Sometimes more than one treatment is necessary.

For Pests on the Roots of Plants, Grasses, etc.—Make holes in the soil to the depth of the pests and pour one or two tablespoonfuls of Carbon Bisulphide into each and close it at once by packing damp earth into it with the foot. In loose sandy or loamy soil make three holes in each square yard, and in compact or "heavy" clay soil make four.

Where the gas is to rise through the air, as in fumigating nursery stock, Hydrocyanic Acid Gas is to be preferred.

28. Corrosive Sublimate, for Insects.

Corrosive Sublimate is deadly poison to all animal life, and there-

fore care must be taken to prevent animals from eating the materials treated. It is used against potato scab and grain smuts. (See also Formalin.)

For Bedbugs.—A mixture of Corrosive Sublimate, one ounce; Alcohol, one-half pint; Turpentine, one-fourth pint, sprayed in all cracks and crevices where bugs might lodge, will effectually rid a house of the pests. More than one or even two doses will probably be necessary. This is a good contact poison and also a repellent.

29. Creolin.

Commercial Creolin is a blackish brown liquid, costing about twenty-five cents a pint. This is highly recommended for dog fleas, which sometimes become very annoying pests in dwelling houses. As the cat and dog are the source of the pest, these animals must be rid of the insects. The animals should be washed thoroughly with a mixture of creolin and water. For dogs a three per cent. solution should be used, or nearly four tablespoonfuls to a gallon of water; for cats a two per cent. solution, or about two tablespoonfuls of creolin to a gallon of water. Mix the creolin well with the water before using.

30. Crude Petroleum.

(a) Strong, for dormant plants.

"The true indication of the safety of petroleum as an insecticide evidently depends upon its specific gravity; as it has been found that petroleum having a specific gravity of 43 degrees or above (Baumé oil scale at a temperature of 60 degrees F.) is less likely to injure trees than petroleum, of a lower specific gravity, although oils of a lower specific gravity have been successfully used in some instances, notably in Canada." (N. Y. State Bul. 202, 1901.)

Where properly used this is one of the best scale insect remedies. It should be applied on a bright, sunny day in early spring, and must be applied thoroughly and evenly; avoid over-drenching.

On perfectly dormant apple or pear trees a 40 per cent. emulsion is used; on perfectly dormant plum trees a 25 per cent. emulsion is used, and on dormant peach trees not over 20 per cent.; and on dormant pear trees 100 per cent., or undiluted Crude Petroleum can be used successfully for Scale Insects, without injury to the trees.

(b) Dilute, for plants in leaf.

Crude Petroleum or "Rock Oil" can be diluted by making into an emulsion or by applying as a mixture with water by using apparatus made for mixing. Use the same percentages and methods as in emulsifying or mixing kerosene or refined lamp oil.

It is not necessary to select oil of a certain known specific gravity if it is to be applied dilute. Crude Petroleum can not be used in making the Kerosene-Lime-Mixture (No. 45), as it forms masses that will not pass through the nozzle.

31. Fish Oil.

Fish Oil is really the basis in the manufacture of Whale Oil Soap, instead of whale oil for the useful insecticide that bears its name. It is also valuable in killing parasites on domestic animals by rubbing them with it. It is also the basis of a valuable repellent for keeping flies from horses and cattle, which is made as follows:

Fish oil, 100 parts; Oil of tar, 50 parts; crude carbolic acid, one pint.

Mix or shake these well together and apply as a spray or mist by means of a hand spray pump.

32. Carbolic Emulsion.

One pound of hard soap, one gallon hot or boiling water, one pint crude carbolic acid.

Shave the soap and dissolve in the hot water, pour in the carbolic acid and churn or beat into a creamy emulsion.

Use one part of the emulsion to 30 parts water. It can be applied as a spray for plant lice or poured on ground around plants, using from a few spoonfuls to a half pint on each plant.

This formula has been recommended as a remedy for the cabbage root worm, but experiments made recently by this office show that one part of the emulsion in 30 parts of water did not kill the pests unless it came directly in contact with them and remained so for a few minutes. One part in fifteen parts of water was more effective and the plants were apparently uninjured by the emulsion on examination four days after the application. It did not kill all the larvæ even at this strength. Its greatest merit perhaps lies in its action as a repellent in preventing the flies from laying their eggs. To be effective it should be applied before the larvæ attack the plants.

33. Hydrocyanic Acid Gas.

It is fully recognized that fumigation with hydrocanic acid gas is one of the best methods of combating scale and other insects on citrus fruits, nursery stock, and small fruit trees. For this reason many nurseries in the region infested with San José scale fumigate all their nursery stock before shipment. The laws of some countries require this, while no nursery stock, except evergreens, can be shipped into Canada without first being fumigated with this gas at the port of entry. All nursery stock liable to infestation by San José scale must be fumigated before being brought into Pennsylvania. The gas is now used in greenhouses, granaries, mills and other buildings subject to infestation by insects or objectionable animals of any kind. The gas is a deadly poison to all animal life and great care must be taken in generating it. Unless thoroughly ac-

quainted with its use, the entomologist or some competent authority should be consulted before handling.

The quantity and quality of chemicals used in the production of the gas must be very accurately determined. The formula per 100 cubic feet of space usually used is:

Potassium cyanide (98 per cent.), 25 grammes (about one ounce); sulphuric acid (1.83 sp. gr.), one-half more acid, liquid measure, than cyanide (about two ounces); water, one-half more water, liquid measure, than acid (about four ounces).

Some of our previously issued Bulletins contain full accounts of the methods of generating and using Hydrocyanic Acid Gas for various purposes, including nursery stock household pests, mills and granaries. Write for them.

34. Lime.

Lime is of little value, if any, as an insecticide, being simply a deterrent and irritant. It can be used wet or dry on foilage without harm. When dusted on pear slugs or other tree-slugs it prevents them doing much damage.

Whitewash is used to prevent sun scald by making a coating on the body of the tree in early spring. To increase the adhesive power make according to the following formula:

Skim milk, six gallons; water, thirty gallons; lime, sixty pounds; Salt, ten pounds. (Can. Expr. Farm Rpt., 1900).

A path or band of air-slaked lime around a plant bed keeps it free from slugs and snails.

35. Lime-sulphur-salt (California Mixture).

Sulplur (either Flour or Flowers), seventeen pounds; quick lime (or fresh lime), twenty-two pounds; salt, ten pounds; water, fifty gallons. Or, fifteen pounds of each to forty-five gallons water.

Slake the lime finely, add sulphur and salt while slaking; cover with water and boil briskly for at least three-quarters of an hour. Add water to make fifty gallons, strain well, and apply as a wash or spray while warm. It is not necessary to use it boiling hot, and the only reason for applying it warm is that it then runs better through the nozzle. (See our previous Bulletins for detailed directions.)

36. Lime, Sulphur, Blue Stone (Oregon Mixture).

The proportions of the lime, sulphur and blue stone in this wash are the same as for the lime-sulphur-salt wash in the preceding. Some persons recommend only one and one-half pounds of blue stone, while others recommend several times as much. This mixture is not to be highly recommended for the reason that the fungicidal value is not greatly increased by blue stone, as the lime-sul-

phur washes, when properly made, are both insecticides and fungicides, without the necessity of adding other material. It was formerly supposed that the addition of blue stone greatly increased the fungicidal value of this wash, but this has not been proven to be true by experiment, while it does unduly increase the expense.

37. Lime-sulphur-soda Wash.

Flowers of Sulphur, twenty pounds; Quick Lime, twenty-five to thirty pounds; Caustic Soda, 5 pounds; water, fifty gallons.

This is to be recommended as an unboiled Lime-sulphur Wash, and to be effective must be made with great care. For details of the process of making this, see pages 208 and 296 of Volume II of the Monthly Bulletin of the Division of Zoology.

This partially takes the place of the boiled Lime and Sulphur Washes, as it is both fungicidal and insecticidal in action, although it is more expensive when extensively used. It is to be recommended only for use on a few trees or in small orchards where one can not make No. 35 or 38.

38. Lime-sulphur Wash.

This mixture has been proven by us in our recent field experiments as well as by others, to be as effective as though salt were used in making it, for Scale Insects, Fungi, etc. It is a fungicide as well as an insecticede, and is to be made and applied in the same manner as No. 41, omitting the salt.

Quck Lime, 20 pounds; Sulphur, 17 pounds; Water, about 50 gallons.

Slake the lime, add the sulphur and enough water to let it boil; boil an hour, and add it to enough water to make a barrel (50 gallons). Strain and apply it either warm or cold, but it runs much better through the nozzle when warm.

Some operators think that this sticks as well as when salt is used. If so, this certainly is the best and cheapest insecticide to be recommended for Scale Insects, Peach Leaf Curl, etc. It must be used when the trees are dormant, but will not then harm any kind, and can not be applied too strong nor too freely.

This is the cheapest good remedy for the San José Scale that is known, and as far as we know at present is the best to recommend in extensive orchards. It fails only when not sufficiently boiled, when there is not enough used or not thoroughly applied.

39. Kerosene-Lime ("Limoid").

Kerosene, 1 gallon; Freshly Slaked Lime, 4 pounds; Water, 10 gallons.

This will make a mixture containing 10 per cent. Kerosene. For

20 per cent. Kerosene, as on dormant trees, use one-half the amount of water, and for 5 per cent. Kerosene and Lime, as for plant lice and young scale insects, use twice the amount of water.

This is practically the mixture that has been advertised considerably as Limoid and Kerosene. The "Limoid" is a commercial product, and this name is given to a particular brand of magnesium lime from a particular kiln. The Kerosene-Lime has been fully tried for scale insects and other suctorial insects, and both from our own careful experiments and recent publications received, we must pronounce it certainly useless as a scale-destroyer.

40. Potassium Sulphide (Liver of Sulphur).

This was mentioned as a fungicide (No. 6), 6a, made with 100 gallons of water, is also a valuable insecticide to use on a few dormant trees for scale insects, etc. It is also recommended as a good insecticide against San José Scale when made as follows:

Potassium Sulphide, 1 pound; Lime, fresh, 1 pound; Water, warm, 2 gallons.

Mix and apply as a spray, or as a wash with a brush, when trees are dormant, or paint on the bark at any time. This is an easily-made substitute for the lime-sulphur washes, but more expensive.

41. Lime, Soda, Caustic Potash, etc.

These are in popular favor, but experiments show them to be of not much use. When trees are dormant one pound of lye to three gallons of water may be used on the limbs of the trees. For trees in foilage, one pound to forty gallons of water, but this will kill only the very tender insects, and stronger than this will burn the foliage.

These substances are valuable to destroy the Peach tree borer when used as follows:

Lye, Caustic Soda or Potash, 1 pound; Hot Water, 20 gallons.

Pour a quart of this mixture, while hot, around the base of each infested peach tree. Stir in any fertilizer that one may wish to add.

42. Pyrethrum.

This is the ground-up flowers of the Pyrethrum plant. It losses strength unless kept in a tight can or jar. When burned in a room it will destroy mosquitoes, flies, fleas, cockroaches, etc. It may be used as a spray, 100 grains of powder to two gallons of water. Use also as a dust or powder, mixed in flour.

43. Resin Soap.

This substance may be used against plant lice and other soft-bodied sucking insects. It may also be used, like the preceding sub-

stance, with Paris Green or Bordeaux, to make these stick to glossy surfaces.

Resin, 2 pounds; Caustic Soda, 1 pound; Tallow, 1 pound.

Dissolve the soda in 1½ gallons of water; then add resin and tallow and dissolve them by applying a moderate degree of heat; add water enough to make 3 gallons.

Before using dilute 1 pint with 16 pints of water. This is a summer wash.

44. Resin Wash.

Resin, 20 pounds; Concentrated Lye, 4 pounds; Fish Oil, 2½ pints; Water, 100 gallons.

Place the resin, lye and oil in a kettle with sufficient water to cover them to a depth of 3 or 4 inches. Boil about 2 hours, making additions of water, until the compound looks like very black coffee. Dilute to one-third the final bulk with hot water or with cold added slowly over the fire, making a stock solution that must be diluted to 100 gallons when ready for use. This is a winter wash.

45. Salt, Nitrate of Soda, etc.

These are good to use against certain pests, such as root lice and root "worms." For example, a remedy that has been highly recommended to destroy root maggots of cabbage, cauliflower, etc., is a thimbleful of salt poured on the roots of the growing plants beside the stalk.

46. Soaps.

(a) Ivory or Common Laundry or Soft Soap.

This is quite valuable as a contact insecticide.

Use Ivory Soap (10c size), 1 bar; Water, 10 gallons.

Apply warm, as it thickens on cooling. It is recommended for Rose Mildew, "Red Spider," Plant Lice, Mealy Bugs on household plants, etc.

(b) Whale Oil Soap.

This is good in combating scale insects in family orchards or in old commercial orchards. It is too expensive, however, for general use.

For the winter spraying of scales use:

Two pounds of the soap to each gallon of boiling water.

This is doubtless the best insecticide to be used as a paint or wash applied upon the bark during the spring and summer. It should be kept from the foliage and young shoots, but will not injure the bark. yet only one application should be made in any one season. All portions of the bark should be covered.

For Pear Slug use:

One-half pound to 1 gallon of water.

For Plant Lice use:

One pound to 8-10 gallons of water.

This dilute solution may be used either as a spray or as a wash into which the twigs and leaves infested with plant lice and young scale insects may be dipped by bending them over into a pan containing the material.

(c) Tak-a-Nap Soap.

This is a new proprietary soft soap with which one can easily make a very good kerosene emulsion by merely pouring the proper amount of kerosene to make the desired percentage of emulsion into the suds or aqueous solution of the soap and stirring it violently or forcing it around through the pump for a few minutes.

47. Sulphur.

(a) Dry, for pests on leaves:

Sulphur, 1 part; Flour or slaked lime, about 9 parts.

Apply as a dust, especially when the leaves are damp, for mites, slugs, currant worms, etc.

(b) In Liquid.

Sulphur, 1 ounce; Water or soap solution, 1 gallon.

Apply as a spray for mites or "red spiders," and some other pests on house plants, roses, etc.

48. Tobacco.

This is a very important contact insecticide. In the form of a fine dust it is excellent for trees affected with root lice; two-thirds inch of surface is taken away from around the tree and 1½ to 2 pounds of dust is evenly scattered over the surface and afterwards covered with earth. The first application should be made in June, and if necessary repeated in August. It may also be used in the form of dry stems against root lice by applying it in the same manner as the dust.

As a decoction of the leaves or stems it may be used as a spray against plant lice; or first spray with water and then sprinkle with the dust. Use tobacco leaves or stems, 1 pound; water, 2 gallons, steep or boil. Its efficiency is increased by adding one ounce of pyrèthrum.

The decoction is also good to kill lice on cattle and pigs.

Tobacco smoke, when generated in an enclosed space, is fairly successful in combating plant lice, as in greenhouses. To rid house plants of these common pests fumigate by burning tobacco beside them in a closed closet, trunk or box.

49. Water.

(a) Warm.

Warm water may be used as an insecticide, as in soaking peas and beans in tepid water for a few hours before planting them to kill the infesting weevils.

(b) Hot.

Hot water, or steam, may be valuable in certain cases. One of the best means of treating house plants for the numerous pests that infest them is to hold them in steam of a teakettle a few inches from the spout, where it is as hot as the hand can be held.

Plant lice dipped in hot water are killed at once. Into a wash boiler of water as hot as the hand can bear dip infested house plants for a few minutes. Nearly all kinds of insects upon them will soon be killed, and with a little experience the operator will learn the greatest length of time that each variety can safely be submerged in water of a certain temperature.

Hot water is also used in killing Clothes Moths and other household insects in clothing that can be submerged in it.

One of the best means of treating Carpet Beetles is to spread a damp towel over the carpet at the spot where it is infested and by ironing this with a hot flat-iron drive the steam down through the carpet and thus kill the pests.

50. (a) Hand-picking.

Where insects are large enough to be seen plainly and can be reached without difficulty it is often advisable to destroy them by picking by hand, as with tomato worms, grape vine, leaf-beetles, stinking squash bugs, tent-caterpillars, eggs of canker worms on small trees, etc.

(b) Jarring.

For insects that are difficult to treat by other means and will drop suddenly when disturbed, as the Curculios, there is no better known means of treatment than to place a sheet or blanket under a tree and jar it severely with a few strong raps by a heavy padded mallet. Then shake the fallen material into a pan of oil on water. A Curculio catcher is made by mounting a sheet on a wheel-barrow.

(c) Shooting.

A standard remedy for such insects as the Tent-caterpillar in many parts of Pennsylvania is to load a muzzle-loading shot gun (no choke bore), with black powder and a paper wad and shoot the nests or tents out of the trees.

(d) Burning.

Fire is a certain and safe means of destroying pests wherever they occur in parts of plants that can be burned. It is much better to sacrifice a stunted and badly-infested plant than to expose

others to infestation from its pests. Always burn all parts possible as soon as this can be done. Do not use fire on live wood.

(e) Cutting out.

One of the most unsatisfactory means of treating certain pests, such as borers, is to cut them out. This should not be necessary, because proper preventive measures (No. 86) should prevent them entering the trees or plants. However, when necessary to kill or remove borers try Carbon Bisulphide (No. 27) or Benzine (No. 25), or insert sharpened pliable wire into the hole and pierce the borer, or insert a sulphur match as far as possible and let it remain. In cutting, always cut lengthwise, not crosswise to the tree or vine, and cover the injured part with grafting wax to protect it. It is practical to cut borers out of squash vines by cutting lengthwise.

TRAPS.

51. Bands of Cloth, etc.

Certain insects, such as codling moths when preparing to pupate, climbing cutworms, etc., will conceal themselves under cloth or burlap bands placed around trees. Such bands should be put in place to serve as traps, and for codling moth larvæ they should be examined and the pests killed at least once per week during the season when the larvæ crawl.

52. Boards, Corn Cobs, etc., on the Ground.

On lawns and in gardens, cutworms, crickets and false army worms, etc., will hide during the day time under boards which may have been placed flat on the ground or grass to attract or trap them. Stinking squash bugs and other pests in the garden can be caught by boards or corn cobs placed on the ground near the plants to be protected. The next morning drop the pests into a can of oil and water. We have trapped many by this means.

53. The Hopper-dozer for Grasshoppers.

The Hopper-dozer is a western invention, shaped something like a long dust-pan, with oil or tar in the pan, to be drawn across fields infested with grasshoppers to trap and kill them. Upon rare occasions we have known certain kinds of grasshoppers to become of sufficient local abundance in Pennsylvania as to demand such a trap. It should be used before they develop wings.

C. COMBINED INSECTICIDES AND FUNGICIDES.

54. Bordeaux Mixture and Paris Green or Other Arsenites.

It is possible by combining Bordeaux Mixture or certain other fungicides with Paris Green or other arsenites to make a combined insecticide and fungicide. It does not really make much difference which fungicide or which arsenite is used, but Bordeaux Mixture

with Paris Green added is the most common combination of this kind, although it is generally not advisable to use such combined mixture upon fruits or crops that are about to be harvested on account of the supposed danger of poisoning them for the consumer. It is so easy to add Paris Green to Bordeaux Mixture and make both an insecticide and fungicide that we advise this whenever Bordeaux Mixture is applied. Hence, whenever spraying with Bordeaux Mixture, Paris Green and an excess of lime to equal twice the amount of the arsenite used, should be added to the regular Bordeaux formula. We recommend this mixture for the Codling Moth, Leaf Spot, Apple Scab and various leaf-eating insects, applied as a spray shortly after the blossoms fall. Use 4 ounces of Paris Green or 1 gallon of Arsenate of Lead to 50 gallons of Bordeaux, according to the regular formula, as though they were being used in water alone.

55. Dust Spray and Paris Green.

To the regular Dust Spray given in Formula 7, add 1 part of Paris Green to 40 parts of the Dust Mixture. Other arsenites can be added in the place of Paris Green if desired and if finely powdered.

D. ADHERENTS.

These are neither insecticides nor fungicides. They are simply materials for making insecticides and fungicides stick to smooth plants such as asparagus, cabbage, kale, cauliflower, kohli-rabi, turnips, celery and onions. The desired insecticide or fungicide must be added to the adhesive mixture.

56. Resin-Lime Mixture.

Pulverized Resin, 5 pounds; Concentrated Lye, 1 pound; Fish Oil or other animal oil, 1 pint; Water, 5 gallons.

Place the oil, resin and one gallon of water in an iron kettle and heat until resin softens. Then add the lye and stir thoroughly. Now add four gallons of hot water, and boil until a little of the mixture when dropped into cold water will mix with it, and give a clear amber colored liquid. Add water to make up for evaporation and make the entire mixture 5 gallons. Keep this as a stock solution, and add two or three gallons to each barrel of liquid spray, whether it be Bordeaux Mixture, or Paris Green and water, or other liquid. The material known as Bordeaux Resin is nothing more than Bordeaux Mixture made by the regular formula with two gallons of this stock solution added to each barrel.

57. Soap.

Soap is used to make spray liquids adhere to such smooth plants

as those mentioned above, adding one pound to from ten to fifty gallons of the spray liquid.

James Good, No. 941 N. Front street, Philadelphia, Pa., has made according to a formula advocated by the U. S. Department of Agriculture, an adhesive soap, which can be bought and used with great success for this purpose. It is similar to No. 62.

58. Resin.

Resin alone added to hot water and kerosene in making kerosene emulsion stock greatly increases the adhesiveness of the kerosene emulsion. Use one pound of the Resin to each one gallon of kerosene in making the original stock emulsion before diluting.

59. Syrup or Molasses.

Any cheap grade of molasses added to a spray increases its adhesiveness, and is consequently useful upon smooth plants. Syrup, 1 pint or more Liquid Spray Mixture, 5 gallons.

60. Glue.

Glue can be used to make a spray liquid stick by dissolving it in hot water and adding it to the liquid.

Glue, 1 pint or one pound; Liquid Spray Mixture, 5 gallons.

61. Flour.

A cheap grade of flour is useful not only as a carrying agent to convey dust spray or insect powders, but when dusted over damp leaves will also help to hold insecticides upon plants.

Flour, 1 part; Diluted Spray Dust, 12 parts, or Flour, 1 pound; Spray Liquid, 5 gallons.

If the flour be boiled with water and made into a regular flour paste, it will be improved as an adherent in a spray mixture.

62. Salt.

Salt is recommended by many persons to increase the adhesiveness of certain washes, such as Lime-sulphur Washes and also Whitewash, Use one pound to three or five gallons of liquid. Brine or salt water is also used to destroy earth-worms by pouring it into their holes.

TIMELY WORK FOR MAY.

1. **Asparagus Beetles.**—Rows of dark green eggs standing on end on the Asparagus stalks and branches, or dark, slimy, small grubs or larvæ, clinging to the plants and eating through the surface are Asparagus Beetles in their immature stages. These are to be destroyed by dusting with freshly slaked lime, where they are on Asparagus that is to be cut and used, and also by methods outlined in the article on this pest in this Bulletin.

2. **Cabbage Root Worms or Maggots.**—Cabbage plants may become of a pale bluish color, fail to grow and wilt almost suddenly, especially on a warm dry day. An examination of the roots shows that the small fibres and outer tissue of the roots has been entirely eaten away and small white maggots or fly larvæ, or oval brown pupæ about 1-3 inch in length, may be found among them, or sometimes in the stem. Also gray flies, not quite as large as house flies, may be seen around the plants at this time of year, and sometimes white eggs or "nits" can be seen at the basis of the growing plants. These latter are Cabbage Root Maggots or Worms in their early stages, and injury by them can be prevented by wrapping the stalk of each plant in a portion of a waste tobacco leaf before setting it. or by making a disk of paper about three inches across, splitting this to the centre, as shown in Fig. 1, so that it can be pushed around the plant which will stand through the centre, and pressing it down firmly upon the ground.

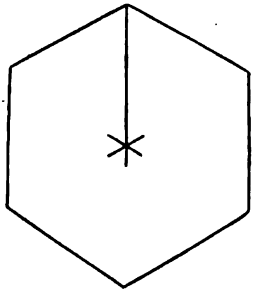

Fig. 1.—Tarred Paper disk in outline, one-half natural size. From Circular No. 63, U. S. Department of Agriculture, Bureau of Entomology, by F. H. Chittenden.

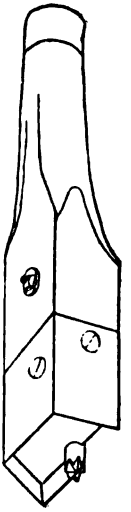

Fig. 2.—Tool for cutting cards, about one-fourth natural size, from same publication.

An easy and rapid method of cutting such disks of tarred paper is to have a tool made for the purpose, such as is shown in Fig. 2. The hexagonal shape of the disk is for the sake of economy, and it is cut from one sheet of thin tarred paper without waste of material, by follow-

ing the method shown in Fig. 3. A thin grade of tarred paper is very good for this purpose and by placing it upon the end of a block of soft wood, the disks can be cut very rapidly by pounding the tool, Fig. 2, as in stamping. The blade of this tool should be made by an expert blacksmith from a band of steel and bent in the form of a half-hexagon, and then taking an acute angle it should reach to the centre where the points cut the place for the plant to stand after the pad is put in place around it at the time it is planted in the field or garden. A more complete publication upon this subject can be obtained free of charge by writing to the Bureau of Entomology, U. S. Department of Agriculture, Washington, D. C., for their Circular No. 63, on "Root Maggots and How to Control Them." Dr. F. H. Chittenden, the author of this circular has published that a Wisconsin firm has used as many as twenty thousand of these cards in a year, and estimates the cost of material and labor at about one dollar for the protection of about one thousand plants. This shows its practicability on a large scale. Of course, pads or disks can be cut by hand with scissors or knife for only a few plants and will be found effective.

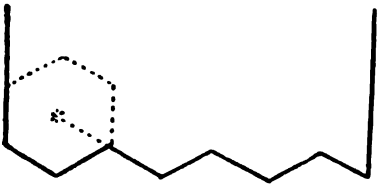

Fig. 3.—Showing how tool is used, dotted line indicating position of the edge of tool, from same publication and author as 1 and 2.

Another preventive is a handful of Tobacco Dust, or a spoonful of sand sprinkled with kerosene oil, placed around the stalk of the plant at the time of setting it. (See Onion Root Worm, No. 9). After these pests have attacked the roots various remedies are recommended, such as half teaspoonful of Salt placed at the base of each plant against the stalk, an injection of a tablespoonful of Carbon Bisulphide just below the roots, or a small cupful of Carbolic Emulsion poured around each plant.

3. **Canker Worms.**—In about twelve counties in the middle part of this State, from Juniata county to Beaver and Lawrence, inclusive, the leaves will be eaten from many forest, shade and fruit trees during this month, and some of these trees will be made to appear quite bare or at a distance will look brown as though swept by fire.

The leaves will first be eaten in small irregular scattered holes, and as the depredators become larger practically the entire blade of the leaf will be eaten away in an irregular ragged manner and portions will be dropped to the ground, cut off by small humping or looping worms or larvæ that are called Measuring Worms, Span Worms or Canker Worms. These were described in our March Bulletin at length and are the Spring Canker Worm (*Paleacrita*

vernata). After they hatch and commence to feed they may be shaken from small trees and tramped on the ground or prevented from climbing by the use of sticky bands or the inverted wire cloth funnel, shown in the March Bulletin, or very loose fluffy cotton bands which must be kept dry or renewed as often as they become wet. The best possible remedy for these pests is to spray them with an arsenite, such as Arsenate of Lead, which is also sold as "Disparene," Arsenite of Soda, or Paris Green. (See formulae elsewhere in this Bulletin).

4. **The Codling Moth.** —All persons are familiar with the light pink "Worm" or larva less than an inch in length which is so frequently found in apples, pears and quinces during the fall, feeding around the core of the fruit, and eating seeds. This is the codling Moth, which will be laying its eggs on the very young fruit shortly after time of blooming. Under no circumstances should any trees be sprayed while in bloom for any diseases or pests of any kind, but just after the petals or showy parts of the blossoms fall, apples, pears and quinces should be sprayed with the combined Bordeaux Mixture and Paris Green and this should be repeated in about ten days. If the work be thoroughly done and the applied material not washed away by hard rains, this will be all that is necessary to control the Codling Moth and produce good fruit.

6. **Curculios of Stone Fruits.**—In the growing fruit of plums and peaches and sometimes apples one will often see crescent-shaped marks and often beneath the flap thus made the egg will be found from which hatches a "worm" or grub which attacks the fruit, especially plums, but often also peaches, cherries and apples, and spoils it or causes it to fall before half-grown. The insects doing this work are Curculios, of which there are two species. They are small brown or gray beetles, not as large as a pea, which have the habit of dropping and remaining perfectly quiet when disturbed. One of the favorite methods of treating trees for Curculios is to jar them with a padded mallet after having spread a large sheet beneath the tree to catch the pests. Shake them together on the sheet and crush or burn them, or pour into a pan of oil. Another remedy is to spray with an arsenite of which Arsenate of Lead is best for this purpose. owing to its adhesive quality.

8. **Cutworms** —In the morning many kinds of plants may be found wilted, and upon pulling them up it will be seen that they have been cut off during the night in an irregular manner, and an examination of the soil to a depth of an inch or two about them will generally reveal the presence of a curled grayish or dirty brown larva, which is commonly called the cutworm. To get rid of these, poison them by methods fully outlined in our March Bulletin, Vol. III, No. 12. It

will also be well to search for them in the soil, especially shortly after a rain, when their miniature mole-like paths are plainly to be seen, and kill them by hand.

7. **Currant Worms.**—On Currant and Gooseberry bushes black and green curled moist larvæ will be found devouring the foilage. They originated as rows of white eggs, laid generally on the under sides of the ribs of the leaves, by a four-winged insect intermediate between a wasp and a fly in size and appearance. The leaves may be entirely eaten away, and the bushes are seriously damaged if this be permitted. The work is done by the insect commonly known as the Currant Worm, which is to be destroyed without trouble by dusting them with white Hellebore, 1 part, and Flour, 5 parts, which have been mixed and permitted to stand in a closed vessel a few hours; or spray or sprinkle them with Hellebore in water; or if the plants be not in fruit spray with arsenical poisons; or dust abundantly with air-slaked lime.

9. **Radish and Onion Maggots.**—Radishes and Turnips are bored by "worms" or larvæ which make irregular tunnels through them, which may become nearly as large as a small wheat straw. The insects doing this work are commonly called Radish Maggots, although they are exactly the same species as the Root Maggots of Cabbage and Cauliflower, described above. Onion plants are also destroyed by a similar insect, which although not the same species, is to be treated in the same way. Into two gallons of sand pour a pint of common kerosene oil and stir it up well. Let it stand a while to let the oil have time to spread and put a small handful of this around each plant, or on the ground along the rows of plants that are to be protected. It will prevent the flies from laying their eggs. Carbolic Emulsion may also be applied with some advantage, but if the work be delayed until the pests are in the roots there is very little that is practical to save the plants.

10. **Root Lice on Corn, Etc.**—Around the roots of Corn and certain other plants, and even some weeds, little holes may often be seen in the soil and small brown ants are to be seen coming and going to these places which they have excavated. The ants themselves are not directly injurious to plants, but if the roots be examined at such places Root Lice or Small White Aphids will be found which are most carefully attended and protected by the Ants. The best possible remedy for such pests is frequent cultivation, keeping the soil well stirred and in good condition.

11. **San Jose Scale.**—On trees which put out leaves only at the interior of the top, leaving the outer branches dead and bare, the San José may be suspected in destructive numbers. While this is the poorest month of the year to reach this pest, something can be

done by cutting away all dead and dying wood, and applying the boiled Lime-sulphur wash with a brush by hand to all the remaining bark, excepting the new growth of this present season. No general spraying for San José Scale can be done while the leaves are on the trees and kill the full grown insects without at the same time destroying the foilage.

12. **Scurfy Scale and Oyster-shell Scale.**—On such woody plants as lilac, willows, ash, poplars, some maples, box elder, horse chestnut, apple, pear, and some others, a lack of proper growth may be observed, and upon close examination the plainly visible gray, curved, Oyster-shell Scale, as illustrated in our previous Bulletins, may be seen. On certain other plants, particularly currant, apple and pear, the white, flat, broad specks of the Scurfy Scale are to be found. The white eggs of the Oyster-shell Scale will hatch about the middle of this month, and the red eggs of the Scurfy will hatch about a week or ten days later. As soon as all the eggs have hatched is the time to wash or spray the plants with common laundry soap, 1 pound in three or four gallons of water, or Whale Oil Soap, one pound in not less than five gallons of water, or about 8 per cent. Kerosene Emulsion.

13. **Plant Lice.**—On some trees or plants the leaves fail to expand properly and the growth of the twig or plant is stunted. The leaves may later swell and curl out of shape, while beneath them or within their folds are to be found very small rounded insects with two long antennæ, six legs, and a pair of abdominal tubes called honey-tubes. These are Plant Lice or Aphis and may be either winged or wingless. Upon the cherry and plum they are usually dark brown, while on most other plants they are light to dark green in color. They multiply with incredible rapidity and injure the plants by injecting poison and sucking out the sap. They are to be killed by the contact applications mentioned just above for young Scurfy and Oyster-shell Scale. The insecticide may be applied as a spray, or by bending the infested twigs over and shaking them in a pan containing the liquid. A very strong Tobacco Decoction (see formula) is also a good remedy, but for the dark-colored species stronger material must be applied than for the Green Aphids. Spraying must be done before the leaves become so contorted or swollen as to prevent the insecticides from reaching the pests.

14. **Striped Cucumber Beetles.**—Attacking the leaves and stems of practically all Cucurbitaceous plants or Cucumbers, Cantaloupes, Melons, Squash, etc., there are small beetles striped with light yellow lines, which eat the leaves and tender stems in scattered irregular spots. While they do a great deal of damage in this way, they do more by laying their eggs in the soil at the base of such plants, from

which hatch their young, which feed as larvæ on the roots of the plants that were attacked by the parents, and a little later in the season the plants will suddenly wilt and die without apparent visible cause. Such pests are the Striped Cucumber Beetles, which can be protected by dusting the plants with Tobacco Dust or Plaster of Paris to which a little Turpentine has been added to give an offensive odor, or by placing Sand with Kerosene around them, and then after either treatment immediately covering the plants with mosquito netting to prevent the entrance of the pests. Of course, they will not crowd through cheese cloth, and if this material be used for a cover the other materials are not necessary. Keep the plants covered until well started, when the Striped Cucumber Beetles will not longer injure them seriously.

15. **Cicadas or Locusts.**—During this month the Seventeen-year Locust, properly called cicada, will appear through the Central part of Pennsylvania from Montour county to Indiana county, and probably in some other portions of the State. We have already published that in the district which they will infest young trees should not be planted this spring on ground that was in woodland or orchard seventeen years ago, or near permanent forests or brushy land. Also small trees should not be trimmed in infested regions until after the eggs of the Cicada are deposited, when the branches that are most injured can be cut away and those that are left will be in much better condition than though trimming had been done earlier and the Cicadas had been forced to puncture them in laying their eggs. It is only by the process of egg-laying that the Cicadas are injurious. They will disappear by the middle of June, and choice trees can be covered by netting or washed with some substance that will be offensive to the pests.

16. **Crows Pulling Corn.**—This can be overcome by planting the corn late, at which time it will be more liable to sprout, and also planting at twice the usual depth, in soil thoroughly prepared and mellow. Another method is to put a spoonful of tar into a bucket of hot water, stir it up well, and pour this over the seed corn, then spread the corn and let it dry. The bitter taste will cause the suspicious crows to leave it alone.

17. **Moles**—While moles feed mostly upon insects and earthworms they may cause some annoyance in gardens by making runways in plant-beds or flower-beds. They can be prevented by pouring Kerosene into their runways, and thus driving them away, or by the use of Mole traps sold by most seedsmen. Watching for them at the time of day when they are active, generally about noon, and closing their tunnels behind them to prevent their escape, after which they can be dug out, is also a common practice.

SPECIMENS RECEIVED DURING MARCH.

Number.	Specimen. Insects.	Date—March, 1906.	Name and Address.
5178	Lady beetle,	1	P. Meyers, Harrisburg.
5179	Oyster-shell Scale,	1	W. F. Stevens, Sterling.
5180	(a) San José Scale, (b) Scurfy Scale,	1	F. G. Fox, Edwinna.
5184	Insect Collection,	2	C. F. Laurie, Erie.
5185	San José Scale,	2	W. S. Stryker, Alexandria.
5191	Oyster-Shell Scale,	5	W. E. Miller, Summerville.
5192	San José Scale,	5	R. W. Path, Grill.
5193	Scurfy Scale,	5	D. F. Gourley, Punxsutawney.
5194	(b) Scurfy Scale,	5	C. Casner, Williamsport.
5199	(a) Scurfy Scale, (b) Oyster-shell Scale, (d) Aphis Eggs,	6	A. Weber, Troutville.
5201	Snowy Tree-cricket Eggs,	6	C. A. DeLong, Mont Alto.
5203	Arctiids,	7	Mrs. G. P. West, Danville.
5204	San José Scale,	7	M. Bullinger, Hanover.
5205	Snowy Tree-cricket Eggs,	7	A. McCord, Fairville.
5206	Oyster-Shell Scale,	7	S. P. Werner, Berlin.
5207	San José Scale,	7	S. J. Bert, Mongul.
5208	(a) San José Scale, (b) Scurfy Scale,	7	I. McFarland. New Bedford.
5209	Canker Worm Moths,	6	W. S. A. Wilson, Avonmore.
5211	(a) Scurfy Scale, (b) Walnut Scale, (c) Aphis Eggs,	7	Zoological Society, Philadelphia.
5212	San José Scale,	7	D. N. Rehr, Lehighton.
5214	Insects and Insect Work,	7	R. P. Marsh, Chester, N. J.
5216	Scurfy Scale,	8	I. F. Mansfield, Beaver.
5217	(a) Scurfy Scale, (b) Aphis Eggs,	8	J. F. Harsberger, Strouds Mill.
5218	Scurfy Scale,	8	D. H. Lovejoy, Roslyn.
5220	(a) San José Scale, (b) Scurfy Scale,	8	S. A. Zeigler, Stewartstown.
5224	San José Scale,	9	M. I. Zeigler, Carlisle.
5226	San José Scale, Oyster-shell Scale—Parasite, Oyster-shell Scale,	8	W. G. Frisbee, Athens.
5230	San José Scale,	8	T. B. Coucher, Coopersburg.
5234	Scurfy Scale,	9	H. S. Gross, Steelton.
5235	(a) Cynip Galls, (b) Scurfy Scale,	9	Dr. Weills, Harrisburg.
5236	Oyster-shell Scale,	9	John F. Rupp, Shiremanstown.
5237	(a) San José Scale, (b) Scurfy Scale,	9	M. M. Snyder, Loganville.
5239	Cosmopepla carnifex,	9	B. Long, Ashbourne.
5242	San José Scale,	10	W. H. Hoopes, Tidal.
5245	Oyster-shell Scale,	12	T. B. Taylor, Pocono.
5246	Scurfy Scale,	12	J. C. Arbegast, McCrea.
5247	(a) San José Scale,	12	I. J. Mest, Oley.
5248	Tree-Cricket Eggs,	12	C. Price, Ellwood City.
5250	(a) Oyster-shell Scale, (b) Scurfy Scale, (d) Wooly Aphis, (e) Springtails,	12	Dr. J. Vallerchamp, McClellan.
5252	(a) San José Scale, (c) Scurfy Scale,	12	Dr. Kalbfus, Harrisburg.
5257	Insects,	13	S. G. Bell, West Middlesex.
5258	(a) Moth Larvae, (b) Work of Moth Larvae,	13	Dr. Weills, Harrisburg.
5259	Mounted Insects, about 25 Spp.	13	G. Brugger, Beatty.
5260	Work of Silver Fish,	13	W. H. Farwell, Uniontown.
5262	(a) Scurfy Scale, (c) Oyster-shell Scale,	13	S. W. Shufft, Alumbank.
5263	Eggs of Tent-caterpillar,	13	A. Noll, Sinking Springs.
5264	San José Scale,	13	S. O. Decker, Athens.
5265	(a) Corn Passalus, (c) Beetle Larvae,	13	R. L. Jackson, McConnellsburg.
5267	Oyster-shell Scale,	14	N. H. Thompson, Scotch Hill.
5268	Canker Worm Moth,	14	H. M. Kelso, McDonald.
5270	Oyster-shell Scale,	15	H. H. Hawkins, Spring Forge.
5271	San José Scale,	15	Mrs. W. A. Wright, Riverpoint.
5275	(a) Oyster-shell Scale, (b) San José Scale,	16	C. S. Dreibellis, Shoemakerville.

Specimens Received During March—Continued.

Number.	Specimen. Insects.	Date—March, 1906.	Name and Address.
5276	San José Scale,	17	D. M. Wertz, Quincy.
5278	Cecropia Cocoon,	19	B. Lobb, Saxon.
5283	(a) Scurfy Scale,		
	(c) Aphis Eggs,	20	H. H. Sloat, Rockport.
5284	Oyster-shell Scale,	20	H. H. Sloat, Rockport.
5289	Pelicinus,	20	C. Anderson, Harrisburg.
5290	(a) Oyster-shell Scale,		
	(b) Scurfy Scale,	21	E. Lienhard, Mauch Chunk.
5291	Oyster-shell Scale,	21	F. Cobb, Factoryville.
5292	(b) Bird Lice from Crow,		
	(c) Ants,		
	(d) Roach,	21	E. A. Weimer, Lebanon.
5293	San José Scale,	21	E. Berger, Pine Grove.
5296	(a) San José Scale,		
	(b) Lecanium,	22	T. S. Halsey, Boothwyn.
5297	Scurfy Scale,	22	F. Newell, Dushore.
5298	(a) San Jose Scale,		
	(c) Oyster-shell Scale,	22	M. G. Davis, West Chester.
5299	(a) Polyphemus Cocoon,		
	(c) Crecopia Cocoon,	22	T. A. Wentworth, Guys Mills.
5300	Collection of Coleoptera of Pa. 1,600 sp. and varieties,	22	H. G. Klages, Pittsburg.
5304	Bird Lice from Crow,	22	F. J. Nester, Ringgold.
5305	Bird Lice from Crows,	22	M. H. Bingaman, Beavertown.
5306	Mealy Bugs,	23	J. Mell, Jr., Richland.
5308	Bird Lice from Crow,	23	M. Brown, North Wales.
5309	Bird Lice from Crow,	23	N. Herb, Reading.
5311	Rose Scale,	24	S. Hassler, Robesonia.
5312	(a) San Jose Scale,		
	(b) Scurfy Scale,		
	(d) Aphis Eggs,		
	(e) Lecanium,	24	Mrs. A. V. Shank, Enhaut.
5313	(a) Oyster-shell Scale,	24	J. A. Reagle, Franklin.
5314	Aphis Eggs,	24	H. W. Gerton, Ridgway.
5316	Bird Lice from Crows,	24	J. J. Kester, Millville.
5317	Bird Lice from Crow,	24	Q. Rhodes, Danville.
5320	Bird Lice from Crow,	26	G. D. Stevens, Maplewood.
5324	Bird Lice from Crow,	26	J. N. McIntire, Sandy Lake.
5325	(c) Bird Lice from Crow,	26	L. S. Bean, Emlenton.
5326	San José Scale,	26	L. M. Rupp, Berneville.
5328	Insect Cocoons in Galls,	27	J. B. Gill, Berwyn.
5329	(a) San José Scale,		
	(b) Bug Eggs,	27	J. E. Miller, Dover.
5331	Galls on Goldenrod and Wild-rose.	27	R. P. Marsh, Chester, N. J.
5337	White Scale (Ivy),	28	G. P. Singer, Lock Haven.
5338	Lemon Lecanium,	28	J. J. Hoffman, Reynoldsville.
5339	Oyster-shell Scale,	28	J. C. Schaller, Mountain Home.
5341	Oyster-shell Scale,	28	J. E. Suhrie, Crumb.
5342	(b) Canker Worm Moth,	28	Rev. J. C. M. Johnson, New Wilmington.
5345	San José Scale,	28	A. Wychoff, Wilkes-Barre.
5346	San José Scale,	28	W. H. Moll, Telford.
5347	San José Scale,	29	A. R. Leinbach, Leinbach.
5348	Oyster-shell Scale,	29	G. F. Miller, West Sunbury.
5350	Leopard Moth Larva (Arctiid),	30	H. W. Likert, Blacklick.
5351	Cynip Gall,	30	C. A. DeLong, Mont Alto.
5352	Scurfy Scale,	30	
	Aphis Eggs,	30	S. V. Crise, Alice.
5353	(a) San José Scale,		
	(b) Oyster-shell Scale,	30	B. L. Weaver, Steelton.
5354	Insects,	30	Mrs. J. W. Atkinson, Buckingham.
5355	(a) San José Scale,		
	(b) Scurfy Scale,	30	E. E. Frankenfield, Bethlehem.
5356	Humming Bird Moth,	30	W. H. Fischer, Coudersport.
5357	(a) San José Scale,		
	(b) Promethea Cocoons,	30	J. B. Gilly, Berwyn.
5358	(a) Scurfy Scale,	30	W. W. Anthony, Climax.
5359	(a) Oyster-shell Scale,		
	(b) San José Scale,	30	A. A. Arnold, Mechanicsburg.
5360	Oyster-shell Scale,	30	J. G. Scouton, Dushore.
5362	Bird Lice from Hawk,	30	R. W. Wehrle, Indiana.
5365	Canker Worms (adults and eggs),	31	O. T. Murphy, Slippery Rock.
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5367	(a) Scurfy Scale,		
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5372	San José Scale,	31	E. M. Zerr, Geigers Mills.
5375	Scurfy Scale,		Hill.

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OUR MONTHLY CHAT WITH READERS.

The State and the Grange in Natural History Studies.

The Grange is the great Farmers' Organization in this State. Let us give due credit to what is being done by the Grange and the Alliance for the up-lifting of the agriculturist. It is our great pleasure to report that a definite effort is being made by members of the Grange to organize the entire State, throughout all the agricultural communities, in a very systematic manner, for the study of the Natural History of this Commonwealth, in order that, on the one side, the citizens of this State may have the opportunity to learn more about the common things which they meet but do not know, and on the other side, the work of this office and the new State Museum will be aided as much as possible by the agricultural citizens, who are in close touch with Nature and have the opportunity to collect specimens or make important observations, which cannot be done by persons who do not live in the very heart of Nature.

The definite organization of this State in such a manner, and the work already accomplished, justify us in making the statement that no State or Country on the Earth has ever before been upon such a footing as Pennsylvania now enjoys in regard to the interest taken in Nature Subjects by the masses of her citizens, especially the agriculturists, who are "The Salt of the Earth." The immense number of specimens monthly received at this office (see last article in this Bulletin), the scores of letters of inquiry and information received daily, the calls for publications, demonstrations, inspections and other forms of help, which we or other specialists can render, all indicate the truth of this statement. It is a most hopeful sign of the times. Such State institutions as this office and our new State Museum would be entirely useless without coming into close touch with the mass of the citizens of the State.

Under the present organization, each county will have its official representative as the intermediary between his associates and these institutions. He will send specimens and notes of observations and will receive and publish information and directions, distribute our publications, and keep in touch with all collectors, hunters, etc., in his county. This is to the State Zoologist the most gratifying announcement he has ever made, because it shows that in this State, without rum, there has been accomplished what Peter the

Great failed to do when he established his famous museum in St. Petersburg and ordered a glass of brandy to be given to each visitor in order to stimulate the interest in Natural History.

The following communication from State Master W. F. Hill, to the Pomona Grange Masters of Pennsylvania is taken from a recent issue of the *Pennsylvania Grange News*, and shows that the work is undertaken in earnest:

The State Master to Pomona Grange Masters.

Worthy Master:

At the last session of the Pennsylvania State Grange a resolution was presented by Brother E. R. Mulford, Wellsboro Grange, 1009, Tioga county, reading as follows:

"Whereas, There are in our State thousands of animals, birds, insects, etc., whose natures have never been studied as to their usefulness or injurious effects upon agriculture, and,

"Whereas, There are many insects, birds, etc., within the bounds of Pennsylvania that are known to be beneficial or injurious, therefore, be it

"Resolved, That the Pennsylvania State Grange hereby instructs State Master, W. F. Hill, to appoint three members as a Zoological Committee, to act under the direction of the Economic Zoologist of the Agricultural Department of Pennsylvania, in supervising the collecting and furnishing of specimens from our Pomona and Subordinate Granges and to further nature study among our members." The resolution was amended, however, so as to read that instead of three members constituting this Committee, it should be made up of one person from each county.

Worthy Master, I want your help in selecting from your county some one who takes an interest in work of this character, and who will make a proper effort for its advancement. Will you not, therefore, please write to me soon and nominate one or two or three members who you think are qualified to do this work? From the members you nominate the appointment will be made. Please indicate with his name and address the name and number of the Grange of which he is a member as well as the county. Where the Pomona district is composed of two counties your nominations should represent members in both of those Counties.

The sisters are eligible and it is hoped that the nominations shall be divided between the sexes.

Send in your names, Worthy Master, so that your county may be included and the name and address of your Committeemen will appear with the others in the next issue of Pennsylvania Grange News." As Brother Mulford has taken an earnest interest in developing the matter in Tioga County Pomona he is hereby recognized as the first appointee under the provisions of the resolution. In this connection it may be interesting to show here what is being done by the Zoological Committee of Pomona Grange, No. 30, of Tioga county. They send out a packet of vegetable or flower seeds without charge to the membership, each one being accompanied by the following circular:

To all Members of the Grange in Tioga County, Pa.:

The Zoological Committee of Tioga County Pomona Grange, No. 30, as a first lesson in Nature Study among our membership, request that the accompanying packets of vegetable and flower seeds, be divided among the younger members in Grange families in each Subordinate Grange in the county, and the results reported as follows:

Note the time of planting. The time it takes to germinate. How it first appears and what growth it makes each week.

How long it takes for the first bud to appear.

How soon blossoms appear thereafter.

The number of blossoms.

Time it takes seed pods or fruit to appear and ripen.

Note what insects work on the plant, injurious or otherwise, and all other data possible.

Reports, with specimens of vegetables and flowers, should be sent to the September, 1906, session of Pomona Grange, when prizes will be awarded.

A list of the prizes for the above will be announced at the June, 1906, session of Pomona Grange.

The seed for these experiments were put up for the committee, free of charge, by Henry Field, Seedsman, Shenandoah, Iowa, at the request of the "Republican Advocate," of Wellsboro, Pa. Mr. Field would be pleased to mail his catalogue to every farmer in Tioga county.

E. R. MULFORD,
Chairman of Committee, Wellsboro, Pa.

I. G. STONE, Secretary.

March 8, 1906.

RESULTS OF PERSONAL EXPERIMENTS.

Summer Experiments for Scale Insects.

These Experiments were conducted during the latter part of June and the early part of July, 1905, in the vicinity of Philadelphia, by Mr. T. C. LeFevre, under the immediate direction of this office. As the results are of considerable importance we publish them in detail: The following key explains the letters used in this Report:

(a) Kind of Plant.
(b) Condition of Plant.
(c) Condition of Scale.
(d) Strength of Insecticide.
(e) Results and Remarks.

For Oyster-Shell Scale (*Mytilaspis pomorum*).

Whale Oil Soap.—(a) Lilac; (b) partially dead, badly infested; (c) all recently fixed; (d) 1 lb. to 4 gal. of water. Bush previously sprayed with Kerosene Emulsion with no results. All Scale killed by Whale Oil Soap.

(a) *Staphylea trifoliata;* (b) slightly infested; (c) all fixed; (d) 1 lb. to 5 gal. of water; (e) majority of Scale killed.

(a) Flowering Currant; (b) one limb badly infested; (c) just fixed; (d) 1 lb. to 5 gal. of water; majority of Scale killed.

(a) *Staphylea trifoliata;* (b) slightly infested; (c) all fixed; (d) 1 lb. to 10 gal. water; few if any Scale killed.

(a) *Staphylea trifoliata;* (b) slightly infested; (c) all fixed; (d) 1 lb. to 10 gal. water; few if any Scale killed.

(a) *Staphylea trifoliata;* (b) slightly infested; (c) all fixed; (d) 1 lb. to 7 gal. water; about 50 per cent. of Scale killed.

Kerosene Emulsion.—(a) Silver Maple; (b) healthy; (c) fixed; (d) 1 gal. stock emulsion (66 per cent. kerosene) to 10 parts water; (e) no apparent effect on Scale.

(a) Lilac; (b) partially dead; (c) all fixed; (d) 1 (66 per cent.) to 5 parts; (e) nearly all scale killed.

(a) Silver Maple; (b) healthy; (c) all fixed; (d) 1 (66 per cent.) to five parts; (e) all Scale seem to have been killed.

For Scurfy Scale (*Chionaspis furfurus*).

Kerosene Emulsion.—(a) Wild Cherry; (b) partially dead; (c) all fixed; (d) 1 part stock emulsion (66 per cent. kerosene) to 10 parts water; (e) all young appear dead.

(a) Wild Cherry; (b) badly infested; (c) all fixed; (d) 1 gal. (66 per cent. emulsion) to 5 gals. water; (e) all young scale dead.

(a) Apple; (b) healthy; (c) all fixed; (d) 1 part (66 per cent.) to 8 parts water; (e) all Scale apparently killed.

(a) Wild Cherry; (b) partially dead; (c) all fixed; (d) 1 gal. to 8 parts water; (e) all scale apparently killed.

(a) Pear; (b) healthy; (c) all fixed; (d) 1 part (66 per cent.) to 8 parts water; (e) all Scurfy Scale killed but tree was infested with San José Scale, also, which was not killed by this spray.

Whale Oil Soap.—(a) Wild Cherry; (b) partially dead; (c) all fixed; (d) 1 lb. to 5 gal. water; (e) Scale all dead. Scales on check trees (untreated) seem to have developed slightly.

(a) Wild Cherry; (b) tree partially dead; (c) 1 lb. to 5 gal. water; (e) Scale apparently dead.

(a) Wild Cherry: (b) partially dead; (c) all Scales fixed; (d) 1 lb. to 7 gal. water; (e) Scale apparently all dead.

For San José Scale (*Aspidiotus perniciosus*).

Whale Oil Soap.—(a) Plum; (b) badly infested, partially dead; (c) some fixed, others active; (d) 1 lb. to 5 gal. water; (e) all young Scale in active condition were killed. Another brood appeared twelve days later.

(a) *Photinia villosa:* (b) healthy, but badly infested; (c) mostly active; (d) 1 lb. to 5 gal. water; (e) young and old Scale killed, but foliage badly burned and plants seem to lose vitality; not killed. (This is the first of these experiments in which the leaves were injured.)

(a) *Photinia villosa;* (b) healthy, but badly infested; (c) Scale very active; (d) 1 lb. to 10 gals. water; (e) little if any effect on scale by spray. No injury to leaves.

(a) Native Apple; (b) healthy, with a few young Scales; (c) just hatching; (d) 1 lb. to 10 gals. water; (e) few, if any Scale killed by spray.

(a) *Photinia villosa;* (b) healthy, badly infested; (c) mostly active, few fixed; (d) 1 lb. to 7 gal. water; (e) some scale dead, but many active.

(a) Native Apple; (b) badly infested; (c) mostly active; (d) 1 lb. to 7 gal. water; (e) Scale active, and few if any killed. Re-sprayed two weeks later with Whale Oil Soap, 1 lb. to 4 gal. Few of Scale killed by last treatment, but many of the leaves burnt by spray. This shows that 1 lb. to 5 gals. water is about the safety limit for the leaves, but is unsatisfactory in killing San José.

Kerosene Emulsion—(a) Native Apple; (b) healthy; (c) few active; (d) 1 gal. (66 per cent.) to 10 gals. water; (e) spray seemed to force the young insects to secrete a covering but did not kill them.

(a) *Photinia villosa;* (b) healthy; (c) mostly fixed; (e) 1 gal. (66 per cent.) to 5 gals. water; (e) all young recently fixed were killed by this spray. Older ones were not affected to any great extent.

(a) Native Apple; (b) healthy; (c) mostly fixed; (d) 1 gal. (66 per

cent.) to 5 gals. water; (e) same effect as above. Spray had no effect on foliage in either case.

(a) *Photinia villosa;* (b) healthy; (c) mostly fixed; (d) 1 gal. to 8 gals. water; (e) few if any Scale affected by spray.

(a) Native Apple; (b) healthy; (c) mostly fixed; (d) 1 gal. to 8 gals. water; (e) very little, if any, result from spray. No noticeable effect on foliage.

(a) Pear Tree; (b) seems to be dying; (c) few active; (d) 1 gal. to 8 gals. water; (e) few scales killed but large number hatched out a week later.

Lime-sulphur-salt Wash, Dilute.—(a) *Photinia villosa;* (b) healthy; (c) mostly fixed; (d) 1 lb. lime, 4 lbs. sulphur, 4 lbs. salt, to 50 gals. water; (e) young scales all killed, foliage burned by spray, but plant was not killed. More young Scale appeared ten days later. Lime used was of a very poor quality.

(a) *Photinia villosa;* (b) apparently healthy; (c) some fixed and others moving; (d) 5 lbs. Lime, 4 lbs. Sulphur, 4 lbs. Salt, to 25 gals. water; (e) rain when spray was applied and for half a day later. Tree badly burned by spray and majority of young Scales killed. Plant seems to have been killed a week later, probably by the combined effects of the Scale and the spraying. (N. B.—This plant is especially delicate.)

The general conclusions from these experiments are that in treating for the Oyster-shell Scale and Scurfy Scale the most important point is to watch and learn what time the eggs have hatched, and spray them as soon as possible after they hatch and before they are covered with a heavy protecting scale. In general, one pound of Whale Oil Soap in five gallons of water is a good formula, but this may injure some kinds of plants, and consequetly the operator should test it and if the plant show no injury within twenty-four hours of a trial spray, this strength will be safe upon such varieties, but if injury be shown, more water must be added until it will be safe. The exact proportions or amount of Whale Oil Soap to use in water for these pests depends upon the variety of the plant, as it is important to use it as strong as possible without injury to the leaves. Slight burning of the foliage will not indicate enough injury to prove serious.

It must be remembered that the Oyster-shell Scale, Scurfy Scale and most other Scale insects (excepting the San José Scale) found in this State multiply by laying eggs, and these hatch in broods, generally two broods per year. At the time they hatch the old are dead and will bring forth no more young. Consequently, if the broods of hatching young be killed, the pests will be exterminated. During the latter part of May and about the first of June are the average dates for the occurrence of these Scale insects, but there

may be some variation, owing to the species of Scale, kind of plant, latitude, altitude and season. It is easy to see the eggs beneath the Scales of the adult insects by using a hand microscope, and the young moving insects will be perceptible to the unaided eye by looking very closely.

In treating the San José Scale the conditions are different, because this pest gives birth to living young, one after another for over a month, and if the first of these or all of the young at any time, should be killed, and the old ones are left alve, within a few days they will continue their multiplication. Thus while one thorough spraying at the right time and with the right kind of material will give relief from most of the other scale insects during the summer time and not injure the vegetation, it requires from eight to twelve applications of the same insecticide, at intervals of a few days each, to kill all of the young San José Scale and reach the limit of reproduction.

Kerosene Emulsion also was found to be a very good insecticide, when used as strong as one part of the stock emulsion (66 per cent. Kerosene) in five parts of water. However, when too dilute it did not have satisfactory results. The limit appears to be one part of the stock emulsion in ten parts of water, which means between six or seven per cent. Kerosene applied. From some of these experiments were Scurfy Scale and San José Scale were both present upon the same tree, it is to be seen that the former were killed while the latter were not. In all of the experiments where Whale Oil Soap was used, this material was dissolved in hot water and then diluted with cold water applied cold.

ORDER X. THE HEMIPTERA: THE BUGS, LICE, APHIDS, SCALE INSECTS, CICADAS, AND OTHERS.

These insects are either with or without wings, but most are winged, having four wings in the adult stage, while all have decidedly suctorial mouth parts or the mouth in the form of a beak or proboscis, and the metamorphosis incomplete, which means that the young have legs and the general form of the adult excepting they have no wings.

Many pests, as well as some beneficial insects, belong to this order. It is the largest Orders of Insects with incomplete metamorphosis, and is generally not properly studied, because too many people regard "bugs" as disgusting, and even many entomoligists would rather chase butterflies or collect moths than to study these lowly

creatures, which may be among our most beneficial or most injurious insects.

The word "Hemiptera" is derived from two Greek words, *Hemi*, "half," and *pteron*, "wing," thus together meaning "half-wing," from the fact that one group or Suborder of these insects, known as Heteroptera, or the "True Bugs," has half of the wing much thicker than the other half.

The Order Hemiptera includes three well marked groups, which are recognized by entomologists as Sub-orders. These are to be discussed, in turn, in these Bulletins, and this issue is devoted to the first, which is known as Heteroptera or the "True Bugs." The Sub-order to which any Hemipteron belongs can be determined easily by the following analytic key:

A. Hemiptera with or without wings, but with a jointed beak.

B. First paid of wings thickened at the base, with thinner extremities, which overlap on the back; beak arising from the front part of the head. Sub-order A. Heteroptera.

BB. Wings all thin and transparent (of the same thickness throughout), and usually sloping at the sides of the body; beak arising from the hinder part of the lower side of the head. Sub-order C. Homoptera.

AA. Wingless Hemiptera, with a fleshy jointed beak, parasitic upon man and other Mammals. Sub-order B. Parasitica.

Sub-order A. Heteroptera. "The True Bugs."

The insects of this Order are those that should properly be called "The Bugs," and the term "Bug" belongs to no other insects than those included in this Group. The word is composed of two Greek words, *Heteros*, "different," and *pteron*, "a wing," referring to the fact that the front or basal part of the upper or fore-wing is much thicker than the outer or terminal part,—the latter being a very thin membrane (See Plate I, A.) This Sub-order differs from Homoptera, the third Division or Sub-order of the Order, not only in the composition of the wing-covers, but also in the fact that the wings are folded over one another, overlapping at the tips on the abdomen when at rest, and lying almost flat upon the back of the body, while they also differ in the direction of the head, which has the beak arising from the front part of the head, rather than from the hinder part or chin. The wing-covers, which are laid flat on the back, are composed of three distinct pieces known as the corium, clavus and membrane, (Fig. N, Plate I, Co., Cl and M.) The insects of this Sub-order are, of course, not to be killed by internal poisons because they do not commence to take their food until after they

have inserted their beaks into the tissue from which they are to obtain nourishment. Thus, Paris Green and other arsenites are useless for this and the other Sub-orders of the Hemiptera or Bugs.

Practically all Bugs have poison glands, which are probably modified salivary glands, in connection with their mouth parts, and are able to inflict injury to animal organisms or the insects upon which they feed by injecting their poison which inflicts paralysis, or rather helplessness, on their victims when these are small creatures, like insects. All of them inject this poison or modified saliva before taking their food or sucking out the sap, which they have thus modified to make more than suitable to their needs, and by injecting such liquids that do their chief injury. Where squash leaves, for example, turn dark, from the bugs, it is not so much due to puncture and loss of sap as to the injection of a liquid that poisons the plant. Many of these insects are liable to insert the proboscis into the skin of a human being, either by accident or through other cause, and inject a slight amount of poison, which may cause a burning or stinging sensation, which is not to be considered very serious. Most of them will not under any circumstances be forced to attack mankind, while others bite him only when squeezed in such a way that the proboscis is forced into the flesh.

Nearly all bugs have the power of emitting a liquid which volatilizes and gives off a very offensive "buggy" odor, which is easily recognized by all country girls and boys, who has eaten ripe berries directly from the vines, and who know that certain bugs are sure to lend such flavors to the fruits. This, of course, is their means of protection from birds or other enemies, and while it is very efficient, many of them are eaten by birds of various kinds, such as Quail, while they also have several kinds of parasites which help to hold them in check, when they become too abundant. For example, we have found a Fly known as the Tachina Fly as the chief enemy in suppressing an outbreak of the Stinking Squash-bug. It is advisable for all persons working with plants to watch carefully these Hemipterous insects which they may see around them in order to learn their habits and to know which are their foes, to suppress them in numbers, and which are their friends, to protect.

The Heteroptera to be discussed in the following pages are grouped into Families under the following scheme or synopsis from Comstock:

A. The Short-horned Bugs. Bugs with short antennæ, which are nearly or quite concealed beneath the head.

I. Bugs that live within water. Families I to V.
II. Bugs that live near water. Family VI.

B. The Long-horned Bugs. Bugs with antennæ at least as long

as the head, and prominent, except in the Phymatidae, where they are concealed under the sides of the prothorax.

I. The Semi-aquatic Bugs. Families VII to X.
II. The Land-bugs.
111. The Land-bugs with four jointed antennæ. Families XI to XXII.
IV. The Land-bugs with five-jointed antennæ. Families XXIII to XXVI.

[N. B.—The various parts or structures of a Bug which are mentioned in descriptions and Keys in this Bulletin are illustrated and named in Plate I, used by consent of Dr. Morgan, Director of Tenn. Agr. Exp. Sta.]

Family I. Corisidæ. The Water-boatmen.

The Family of the Water-boatmen or the Corisidæ departs from the normal types of the Heteroptera or Heteropterous insects in having the beak sharp and short and directed backward beneath the body and the head overlapping and fitting against the prothorax or front segment. The insects of this family are elongate oval in shape, and in color are gray and black mottled, all being less than one-half inch in length, and in the most common species being not over one-fourth inch or at least shorter than that. They may readily be recognized by living in swarms or gregariously and by holding their middle pair of legs like oars at right angles to the body and resembling miniature boats driver by these oars. It is from this that they take their common name.

The Water-boatmen may be found in almost any pool or slow stream, especially where aquatic plants are abundant, where they may often be seen resting with the tip of the abdomen and the ends of the legs at the surface of the water, but readily start away through the depths to find concealment at the least disturbance. Their legs are flattened and fringed with hairs in such a way that the hairs do not catch the water on the forward strokes but do so on the backward stroke, thus presenting the broader surface to propel them forward and aid them mechanically in their swimming. The body is enveloped in a film of air, which glitters like silver armor when seen beneath the water. It is this air that these aquatic insects breathe, while they are beneath the water, rather than oxygen dissolved in a liquid. It is purified by coming in contact with the oxygen of the water, and consequently these insects are able to live for a long time beneath the surface of the water without being forced to come to the top of the water to breathe. Owing to the film of air which covers them, they rise readily to the surface of the water and find much of their food. They often float on the

top of the water and can either dive beneath and find protection or can easily take flight into the air from such place. They are found in all rivers and lakes where the conditions as to food and sufficiently quiet water favor their existence, and deposit their eggs upon the submerged aquatic vegetation. In some parts of Mexico and the Southwestern United States these eggs are so common that the aquatic plants are dried and beaten, and the eggs are thus collected, dried and used as food. The Indians consider them quite a luxury, and sprinkle them over nearly every article of diet somewhat as we use salt or pepper.

These insects are easily kept in an aquarium, and their methods of living are very interesting and easily observed. Their chief food consists in small fish eggs, insects and very young fishes. We have found them taken extensively as the food of young trout and young bass, especially the latter, and have sometimes found the stomachs of young bass packed so full of them that nothing more could be swallowed. Thus they, like many other insects, have both beneficial and obnoxious features as far as the interests of mankind are considered, but in the economy of Nature they have a more important role to play by the purification of the water or by other means than we have yet suspected.

The Family of Corisidæ contains but one genus in America, and this has been given the scientific name "Corisa." Our more common species is *Corisa interrupta.* It is a very difficult matter to distinguish the different species scientifically as most of them are quite small and very closely allied.

Family II. Notonectidæ. The Back-swimmers or Back-swimming Water-boatmen. Plate IX, Fig. 1.

The insects of this Family are commonly called the "Back-swimmers," because they turn on their backs and are decidedly boat-shaped and swim readily, reminding the observer of nothing as much as a very small boat, being driven through the water by one or more pairs of oars. Their hind legs are flattened and cling to hairs, and consequently aid in forming the paddles or oars with which the body is driven forward. The back is keeled like the keel of a boat, and their swimming arrangements are perfect. They are common in most low pools or slow streams where there is aquatic vegetation and seemingly take pride in swimming away in the water to another place to take air to sustain respiration. As they carry a bubble of air beneath their wings, when they dive this helps them in coming quickly to the surface, and they do not, as a rule, stay beneath the surface of the water unless they cling forcibly to some object which holds them down.

These insects, as most other representatives of this Sub-order,

have strong beaks or mouth parts that are provided with poison glands, and are able to inject considerable poison into their victims, oftentimes affecting quite a severe sting when they have opportunity to insert their beak into the thin skin of one's hands, as between the fingers. The bite is not as severe as the sting of the Bee, but it is sharp enough to be painful. These insects are very attractive to keep in aquaria, and as they are easily collected, they will prove of considerable interest.

Economically they are obnoxious or injurious rather than beneficial, as they have been known to live upon May Fly larvæ (*Ephemeridæ*), the Water-boatmen (*Corisa alternata*), Dragon Fly larvæ and small fishes. In destroying the Dragon Fly larvæ they are obnoxious because the latter insects are beneficial in feeding upon the Mosquitoes in their younger stages. The Water-boatmen feed upon fish eggs as well as small fish, and in fish ponds may do considerable damage in this way although they will at times also be taken as food by fishes.

In the spring of the year and in summer these insects fly to bright lights at night, as do the various species of the preceding Family, and we here offer the suggestion that it may be possible to collect them and reduce their numbers in choice fish ponds by hanging lights over the waters and providing for the pests to fall into pans of oil fixed beneath the lamps. We have at times seen them swarm in great number around the electric lights or lamps of cities. In this State there are three genera and several species found, but a more detailed discussion of these is left for a technical work on the subject.

Family III. Nepidæ. The Water Scorpions. Plate II, *a*.

The Water Scorpions are so named because they have somewhat the resemblance of Scorpions, with their clasping, short front legs and long pointed caudal appendages. This is the only Family of bugs which has a long respiratory tube or caudal appendage, which is conspecuously and permanently fixed to the body outside of the wings. This long breathing tube, really two half-tubes lying close together, makes it possible for these insects to lie on the bottom of a pool or cling to submerged vegetation and plants and reach to the surface of the water for the free air which they breathe. They do not swim freely as do the species of the two Families discussed previously, but they crawl slowly about among sticks and rubbish and stems of aquatic plants, swimming only under such circumstances as would cause them to become very active.

There are two genera in this Family, which may be distinguished as follows:

a. Body oval, less than three times as long as broad. *Nepa* or Water Scorpion.

aa. Body elongate, more than five times as long as broad, *Ranatra* or Water Walking-stick.

The Nepa or Water Scorpion is a curious looking creature, which has recently been collected by our collector in the famous Wetzel's Swamp, at Harrisburg, and resembles a brownish leaf with stamen or petiole attached. Its sharp and strong front claws are especially adapted for catching its prey, and it feeds upon other insects of various kinds, small fishes and fish eggs. Its resemblance to a submerged leaf no doubt gives it concealment so that its unsuspecting victims come quite near to its treacherous grasp before they become aware of the proximity of an enemy.

The Water Walking-stick or Ranatra is also predaceous, but its movement is very slow and deliberate, yet by quick use of its strong and hooked front legs is able to capture small fishes and aquatic insects of various kinds and also to hold fish eggs which it eats. Prof. Uhler writes of this insect: "During the warm summer weather it may be seen at times resting at the bottom, stilted on its legs, with the respiratory tube projecting upward, just a little outside the surface of the water. At such times it rests motionless for intervals of an hour or more, but at other times it searches for the eggs of pond fish, which it destroys by drawing out their contents; and it occasionally attacks the young fish of other kinds, grasping them with its curved four claws and sucking their blood.

In seining for minnows and other small fishes in quiet ponds we have often collected these in numbers, owing to the fact that their legs and bodies are so long that they do not pass through the minnow net. They are strikingly like the Orthopterous insects known as "Walking-sticks" in general external appearance, and we have no doubt but that their structure and form give them protection and permit them to lurk in vegetation and brush and seize their unsuspecting victims as they come near, just as the Nepa resembles a submerged leaf and takes its food, which may be deceived by its appearance. If either of these two genera of insects should become abundant in a choice fish pond and be found to be doing much damage to young fishes, it is possible to get rid of them by seining with a regular minnow net or seine, or even with common mosquito netting.

Family IV. Belostomidæ. The Giant Water-Bugs or Electric-light Bugs. Plate III.

Around electric lights in the spring and summer it is common to see large flat bugs striking in the air with paddle-shaped legs fringed with hairs and resembling the oars of a boat and flopping

irregularly on the sidewalks. Owing to the great abundance of these insects since the introduction of electric lights, they have become well known as the "Electric-light Bugs." Before this modern convenience for mankind was in common use, these insects were considered comparatively rare. They live altogether in the water where they breathe by means of extensile respiratory tubes, which are mostly retracted within the body and here they lay their eggs and rear their young. When seen out of the water they are generally flying through the air for the purpose of finding suitable places to mate or lay their eggs and propagate their species, or flying from ponds that are drying to other water where they can continue to find the requisites for their existence.

To this Family belong the largest insects of the Order Hemiptera, and consequently they are called the "Giants" or "Giant Water-bugs." The bodies are so remarkably flat as to have the appearance of having been crushed by someone stepping upon them. The front legs are curved and especially fitted for holding the live creatures upon which they feed. This flattened shape makes it possible for them to plunge beneath the thin mud and thus find protection or lie in wait beneath submerged leaves in the water and easily dart out at passing fishes, frogs or insects.

There are three genera belonging to this Family, which are shown in Plate III and distinguished by the following key:

Hind-tibiæ much broader than middle tibiæ. Fore-coxæ little longer than broad.

Ventral margin of fore-femora with a longitudinal groove in which the tibiæ lie when folded, ...Belostoma.

Ventral margin of fore-femora convex, without a longitudinal groove, ...Benacus.

Hind-tibiæ little, if any, broader than middle-tibiæ, fore-coxæ at least twice as long as broad, ...Zaitha.

The largest one is *Benacus griseus*, and the next in size is *Belostoma americanum*. The chief difference between these two species of Giant Water-bugs besides the slight difference in size and color is that the former has a groove along the margin of the second joint (femur) of the first pair of legs into which the next outer joint (tibia) fits, while in the latter there is no femoral groove. Their habits and haunts are similar, as they both live during the day concealed beneath mud or among vegetation or beneath sunken leaves in water, and at any time a small fish or aquatic insect of almost any kind passes the quiet water, the bug darts forth and seizes it with its sharp, hooked claws, and kills it by injecting poison with its strong beak and sucking out its life blood. These insects have power to inject considerable poison into any object in which they sink their beaks, and while it is safe for a person to handle

them if done with care, it is best to keep the fingers away from the sharp beak, as a puncture inflicted by it is nearly as severe as a bee sting, although it cannot be called particularly serious.

They deposit their eggs in masses of from forty to sixty or more, (See II, b), and glue them together with a mucilage-like substance, which also holds them to the objects on which they are laid along the borders of the ponds, often beneath bark or logs. The food consists of fish eggs, small minnows and other fishes, and aquatic insects of various kinds.

There is also another species of bug found in the water of this State beloging to this Family, shown in Plate III, and known as the Lesser Water-bug or *Zaitha fluminea*. These are remarkable for the females, which are larger and stronger than the males, capture and hold the latter and glue their eggs to the backs of their captors where the male insect is obliged to carry them around until they hatch and are able to provide for themselves. This insures them protection from enemies by the watchfulness of the male in taking care of himself. The bugs of this species are similar in habits and food to those just described.

The Giant Watèr-bugs are in no wise obnoxious on land, excepting where they become so abundant beneath electric lights as to soil the sidewalks, when all that is necessary is to scrape them away, but if they should occur in such numbers in choice fish ponds as to prove destructive to the fishes it is possible to catch them by minnow nets, and we would suggest attempting to trap them with bright lights placed over pans of oil. They have never been known to fly to lights abundantly until the brilliant electric lights came into use, and from this they are called the "Electric-light Bugs."

Family V. Naucoridæ. The Creèping Water-bugs.

These are the small flat-bodied oval insects living in the water and represented by one species, *Pelocoris femorata*, and this is often collected. It is yellowish brown in color and lives by partly crawling and partly swimming among the stems of plants in the water, and is predaceous, feeding upon small insects that may come within reach.

Family VI. Galgulidæ. The Toad-shaped Bugs.

There is but one common species, *Galgulus oculatus*, of this Family found in Pennsylvania. While this is not strictly aquatic it is found near the muddy margins of streams where the soil is always wet, and some species of this Family make burrows in the mud in which they live. They are the color of mud and in procuring their food as well as escaping their enemies are greatly aided by this coloration. They are broadly oval, with prominent eyes, considerably resembling miniature toads, and for this reason are called the "Toad-shaped Bugs." They feed upon other insects which they capture by creeping

slowly to within a short distance of them, and then suddenly leaping upon them and grasping them with their powerful front legs and killing them with their poisonous beak after which they suck their blood. Nature has provided these insects with a granular covering resembling velvet, the purpose of which appears to be to gather and hold a coat of mud or green slime, rendering them protection in escaping their enemies and keeping their food. They are in no way injurious to mankind, and are probably beneficial in their feeding habits, excepting when attacking Dragon-fly nymphs, as the Dragon-fly feeds upon Mosquitoes and should be preserved.

Family VII. Saldidæ. The Shore-bugs.

While the Shore-bugs live in the same general region as that inhabited by the Toad-shaped Bugs they prefer banks of some weeds or grass around the roots of which they may hide. They are also often found in rock beds of streams. They are easily distinguished from the species of the previous Family by the presence of long feelers or antennae, which are in concealment beneath the head. As with the foregoing their heads are long in proportion to their bodies and antennae long and conspicuous. They are numerous in this State along the sandy beaches of lakes and also in the water. Prof. Uhler writes of them: "Their manner strongly recalls that of the Tiger-beetles that inhabit the same places. When approached, or in any way disturbed, they leap from the ground, arise a few feet into the air, by means of their wings, and alight a short distance away, taking care to slip quickly into the shade of some protecting tuft of grass or clod, where the soil agrees with the color of their bodies."

There is in this State but one genus, *Salda*, of several species. They feed upon dead Flies and other insects and suck the blood from them, and in this manner they act on them as scavengers. There is no doubt of the fact that many of the aquatic insects perform valuable service to mankind in acting as scavengers, feeding upon decayed tissues or sucking the juices from objects which would otherwise contaminate water that would be useful to man or the lower animals.

Family VIII. Veliidæ. The Broad-shouldered Water-striders. Pl. IX, Fig. 2.

This is a small Family of bugs with long legs, wide at the prothorax or part to which the front legs are attached, rather small in size, with the legs fitted for running over the water, but also able to travel upon land. They often live in groups and feed either on the shore or in the water, being predaceous and live mostly upon other insects.

Family IX. Hydrobatidæ. The Water-striders. Plate IX, Fig. 3.

The insects of this, familiar to all persons who have been along the streams of this State and have observed the long-legged insects commonly called "Skippers" or "Skaters," which live quietly on top of the water, but when disturbed or alarmed skate away as smoothly and gracefully as though on smooth, firm ice. They are able to remain on top of the water by virtue of their very long legs, which displace enough of the water by displacing the surface film, without breaking through, to be sufficient to sustain their weight on the same principle, as we observe in floating an oiled needle on the surface of water. Also the undersides of their bodies are pubescent or covered with hundreds of minute velvety hairs, which are set so closely together that the water does not penetrate them, and consequently between them there is a film of buoyant air that permits them to rest on water without sinking beneath its surface. These insects as well as the preceeding are interesting and peculiar because of the adult insect, which may be winged or wingless, and one form may predominate one year and another another year, without different apparent reason as to the cause, unless it be due to temperature. In some species the winged form is common, while in others it may be rare. There are two genera of this Family, one of which has a short oval body, while the other has a long boat-shaped body so commonly seen on the waters of this State. Some species are pelagic, living out in the open sea hundreds of miles from land, where they feed upon the juices of floating dead animals. "The insects stow themselves away under the banks of streams, in the mud beneath leaves or rubbish, or at the bottom of water under stones and roots of trees, when the autumn begins to get cold; from thence they reappear upon the surface of the water as soon as the warm weather of spring returns. Soon after this the eggs are attached by a sort of glue to the leaves and stems of aquatic plants. They are whitish, translucent, long, cylindrical, more blunt at the end from which the young emerges, than at the somewhat tapering, but round, opposite extremity. If the weather continues to grow warmer, the eggs mature in about two weeks; then the larvae push their way out, not, as in many Heteroptera, by thrusting up the lid, but by bursting through a slit which opens a little down the side." (Minn. Bulletin No. 69.)

They are both predaceous and scavengers, feeding upon insects of various kinds that drop into the water and from which they are able to suck the blood, whether living or dead. Thus they do considerable good, and are not known to have any objectionable qualities in reference to the interests of mankinid.

Family X. Limnobatidæ. The Marsh-treaders.

This is a small Family of very small, slender aquatic bugs represented in this State by one species *Limnobates lineata*, about one-half inch in length, which is not rare, but is not often seen because it is small in size, quite in habits and so slender and thread-like that it escapes observation. "It crawls about on the surface of the water or mud, or climbs upon water plants and sticks projecting from the water; it seems to prefer stagnant ponds or marshes. We do not know upon what it feeds." (Comstock.)

Family XI. Emesidæ. The Thread-legged Bugs. Pl. IV, *a*.

All species of Heteroptera or "True Bugs" thus far mentioned were aquatic. The following families are not, but are terrestrial or aerial, and do not have concealed feelers or antennae as have most of the aquatic insects. It can be seen that long antennae or feelers would be practically useless for insects living in the water, while they would at the same time be likely to be torn or injured by being entangled in the fine aquatic vegetation.

The insects of this Family are called the "Thread-legged Bugs," because their legs are so very long and slender that they look like many jointed threads. The body is also very long and slender and the wings quite short. The front legs are shorter, stronger, fitted with sharp spines and adapted for grasping. "The fore-legs are most formidable instruments in catching and securing the insects upon which it feeds; the long fore-coxæ project far in front of the head, and furnish a swinging joint for the spined femora, which can be thrown forward like a flail, while at the same time the sharp tibiæ are shut back against the acute spines, and the victim thus irretrievably transfixed." (Uhler.)

One species, *Emesa longipes*, is common in this State; Dr. Lugger says of this, "It is most frequently seen in old stables and other outhouses, hanging from the rafters and roof by its very long front and hind legs, or crawling slowly about in search of flies or other insects, which it seizes with its front legs and then sucks their juices with its sharp pointed beak." It is consequently decidedly beneficial in destroying flies, which are pests of live stock and of mankind and which also carry disease germs.

Family XII. Reduviidæ. The Assassin Bugs.
Plates IV, b; V, and IX Nos. 4. 5. 6 and 7.

We now come to the first large Family of conspicuous land bugs that are familiar in this State. There are a great many different family genera and species, and they are all called the "Assassin Bugs," because of their habit of lying in wait for their prey, seizing it with their sharp claws and small raptorial legs, piercing it with

their sharp beaks and injecting the customary poison of this order, producing paralysis or a killing effect, while the juices of the victim are sucked for the nourishment of the assassin. In general these are beneficial insects because they feed upon insects, many of which are injurious to the property of man, particularly vegetation, but some attack the higher animals and may even injure mankind. Because they are predaceous the number of individuals of any one species rarely becomes great. They are limited in numbers by the amount of food they are able to find, but they are important safety checks upon outbreaks of insect pests, because if the pest should commence to increase in numbers, these beneficial insects would feed upon them and in turn increase. They have power of injecting poison from the three-jointed beak into the hand of the collector, and consequently should be handled with care, although their bite is not as painful as a bee sting.

One of the remarkable insects belonging to this family is the "Masked Bed-bug Hunter." (Pl. IX, Fig. 7.) Its body and legs are completely covered with dust, forming a very perfect mask as it moves slowly about, searching for Flies, Bed-bugs and other insects. It wears a mask only while it is young and after it molts or becomes fully mature it is no longer covered. It lives mostly in the Atlantic States. It is one of the forms of bugs that has been given the popular name of "Kissing Bug." There is a possibility of its attacking mankind occasionally, but most of the newspaper stories about it were only inventions, while others had but little basis of fact. The unskillful collector is quite liable to be severely bitten by it, and the pain and swelling are more severe than from other insects of this order. Dr. Leconte states "that it is remarkable for the intense pain caused by its bite, and when caught and unskillfully handled it always bites. In this case the pain is almost equal to that of the bite of a poisonous snake, and the swelling and irritation which result from it will sometimes last for a week. In very weak and irritable constitutions it may even prove fatal."

In the South there is another species of Assassin Bug known as *Sinea diadema*, which feeds upon the destructive cotton Caterpillars, as well as Canker Worms and is decidedly beneficial. In this State we have a closely allied species, which is often found among the flowers of the goldenrod or other plants, where it lies in ambush for various kinds of insects upon which it feeds. The Assassin Bugs are not particular in the food taken, and will take with the same readiness a bad-smelling bug, a caterpillar, fly, moth, and even such insects as bees and wasps. For this reason many of them are not the friends of bee-keepers and near bee hives should be watched and kept in check.

In the southern and western portion of this State there is found

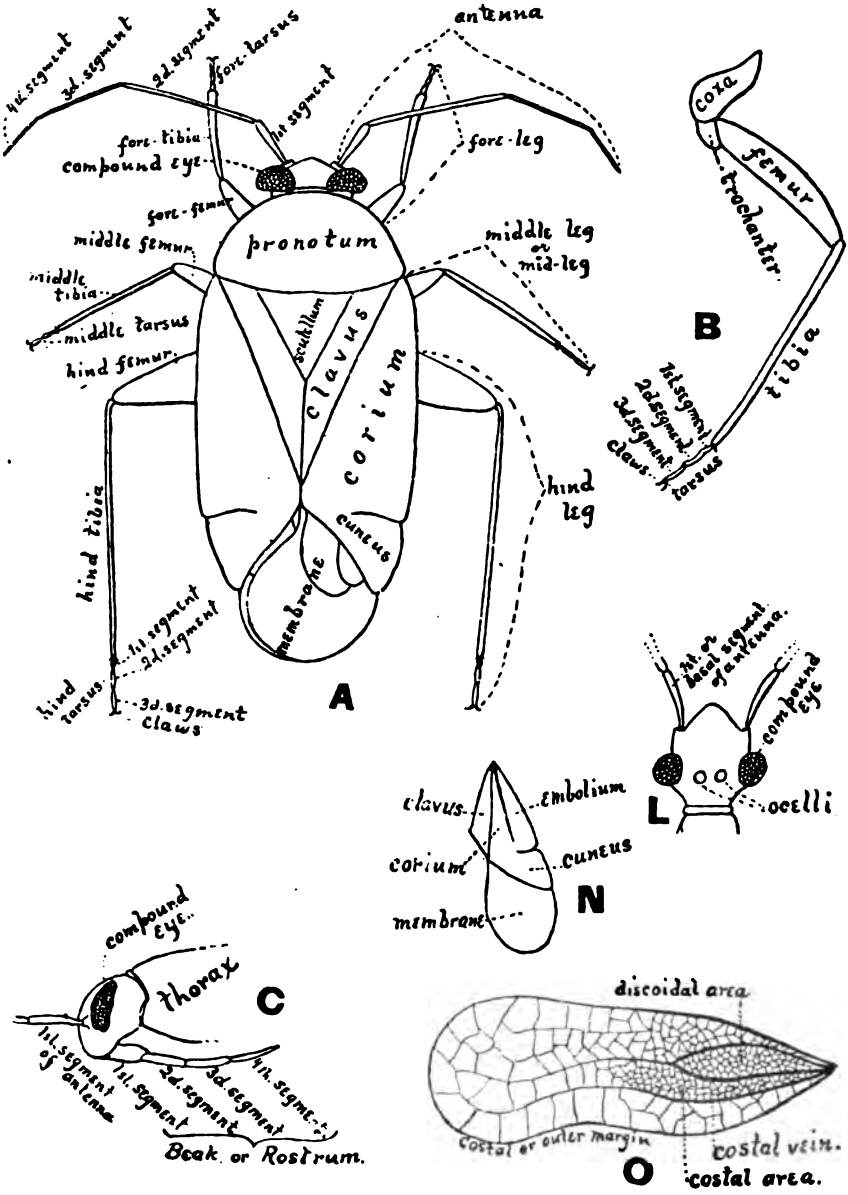


PLATE I

Showing the Structures of Hemiptera or Bugs. The parts shown here are those used in classification.

From Prof. Summer's "Heteroptera of Tennessee" Tenn. Exp. Sta., Vol. IV, No. 3, 1891.

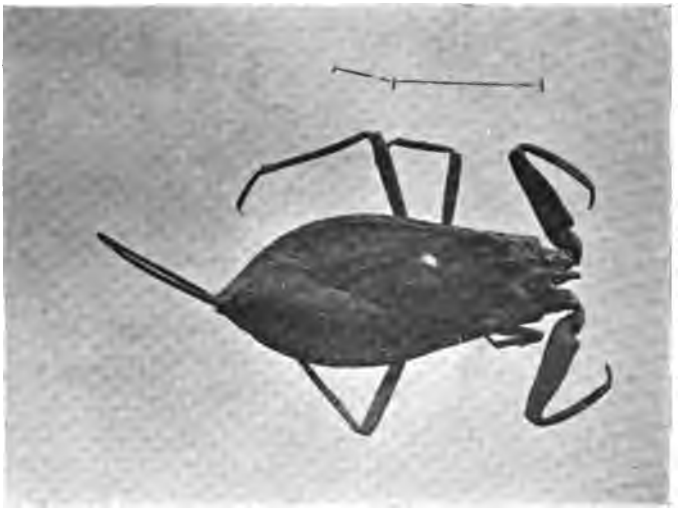


PLATE II.

a. Water Scorpion. *Nepa apiculata*, about twice Natural Size. Photograph of a specimen in our State Collection.

PLATE II.

b. Eggs and Young (just hatching) of *Belostoma americanum*, or Giant Water Bug. Photographed in Office of Economic Zoologist. From living specimens in our collection. H. A. S.

PLATE III.

Upper, *Benacus griseus*, or Gray Giant Water Bug. Middle, *Zaitha fluminea*, or Lesser Water Bug.
Lower, *Belostoma americanum*, or American Giant Water Bug.
All natural size and original photograph.

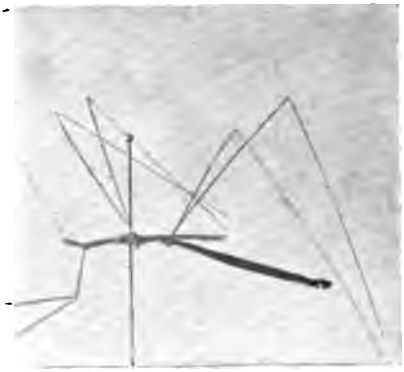


PLATE IV.

a. Thread-legged Bug or *Emesa longipes.* Nearly natural size.

PLATE IV.

b Acholla, or Assassin Bug eating a Cut-worm, just as it was found by our collector. About natural size.

PLATE V.

a. Wheel Bug, *Prionidus cristatus*, Natural Size. A common beneficial insect.

PLATE V.

b. Eggs of Wheel Bug, natural size. Photographed in Office of Economic Zoologist.

PLATE VI.

a. Ambush-bug, *Phymata erosa pennsylvanica*, Sucking the liquid of a house fly which we saw it kill.

PLATE Vi.

b. A Stink-bug, *Podisus*, killing a Plum Curculio. Photographed in Office of the Economic Zoologist.

PLATE VII.

Fig. *a*. Eggs of the Squash Bug (*Anasa tristis*), natural size, *in situ*, on the under side of a squash leaf. This shows the regular distance between the eggs, the diagonal direction of the rows, and the irregular shape of the patch as a whole. Photographed natural size, by H. A. Surface.

PLATE VII.

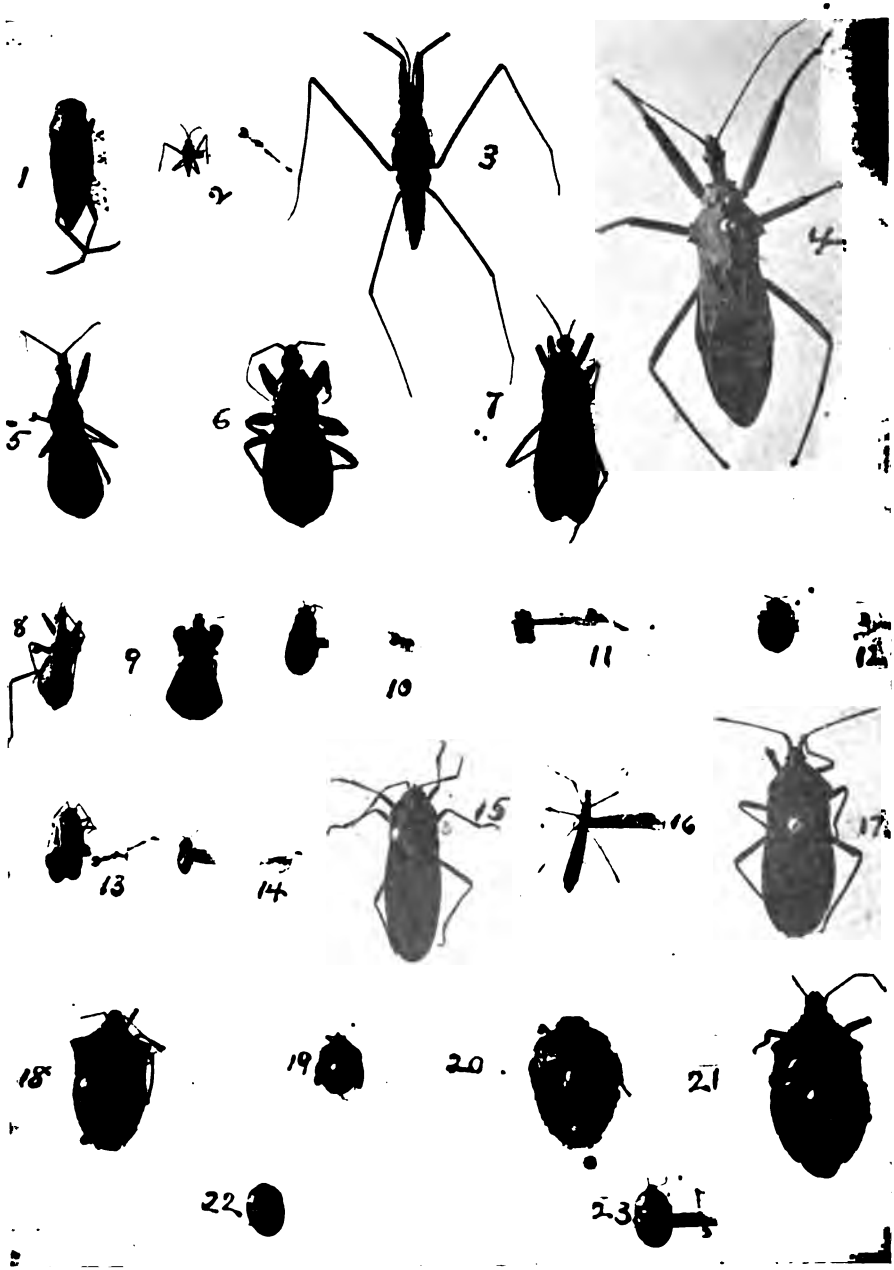
Fig. *b*. Eggs of Parasites on Squash Bugs. It was through the abundance of these parasites, destroying the fall brood of 1901 after it became adult, that the bugs were rare and crops were free from serious injury during the season of 1902. Slightly more than twice natural size, by H. A. Surface.

PLATE VIII.

Fig. *a*. Board Trap, showing effectiveness for Squash Bugs. Photographed in the garden of the Economic Zoologist.

PLATE VIII.

Fig. *b*. A group of Squash Bugs on a dead leaf in the Fall, showing where they can be killed by a stronger kerosene spray. Photo. by H. A. Surface.



EXPLANATION OF PLATE IX.

1. The Undulating Back-swimmer (Notonecta undulata). Notonectidæ.
2. Broad-shouldered Water-strider (Rhagovelia obesa). Veliidæ.
3. A Water-strider (Hygrotrechus remigis). Hydrobatidæ.
4. The Wheel Bug (Prionidus cristatus). Reduviidæ.
5. Many-spined Assassin Bug (Acholla multispinicsa). Reduviidæ.
6. So-called "Kissing Bug" (Melanolestes picipes). Reduviidæ.
7. Masked Bed-bug Hunter (Opsicœtus personatus). Reduviidæ.
8. The Black Damsel Bug (Nabis subcoleoptratus). Nabidæ.
9. "Bee-killer" (Phymata erosa pennsylvanica). Phymatidæ.
10. Common Flat-bug (Neuroctenus simplex). Aradidæ.
11. Hawthorne Tingis (Corythuca arcuata). Tingitidæ.
12. The Bedbug (Acanthia lectularia). Acanthiidæ.
13. Four-lined Leaf-bug (Poecilocapsus lineatus). Capsidæ.
14. The Chinch Bug (Blissus leucopterus). Lygæidæ.
15. Milkweed Bug (Oncopeltus fasciatus). Lygæidæ.
16. Spined Stilt-bug (Neides muticus). Berytidæ.
17. Squash Bug (Anasa tristis). Coreidæ.
18. A Stink-bug (Euschistus Sp.). Pentatomidæ.
19. A Stink-bug (Cosmopepla carnifex). Pentatomidæ.
20. A Plant-bug (Brochymena, young or nymph). Pentatomidæ.
21. A Plant-bug (Brochymena sp.) Mature. Pentatomidæ.
22. A Negro-bug (Corimelæna unicolor). Corimelænidæ.
23. A Burrower-bug (Canthophorus cinctus). Cydnidæ.

All Photographed in the Office of the Economic Zoologist from specimens in the State Collection. H. A. S.

very commonly a large insect belonging to this Family and known as the Wheel Bug (*Prionidus cristatus*). (Plates V and IX, 4.) This receives the name Wheel Bug from the crested and spined prothorax or part above the back, which has the appearance of a cogwheel with projecting cogs. Its eggs are laid in masses upon trees of various kinds, and look like a number of little jugs set closely together on end in irregular shape and arranged in rows within this shape. We often find these beneficial bugs in nurseries and orchards in the southern part of this State, and take this opportunity to call attention to their great usefulness to mankind and the fact that they should be preserved. The young or nymphs are blood-red with black marks, and in our living cages they have fed extensively upon plant lice; as they become older they attack larger insects. The old or mature insect is gray in color with long legs and antennae and found on various kinds of plants where it seeks its food. Its victim is killed by the insertion of its proboscis and the injection of powerful poisons which soon produce paralysis and death to the insect which it attacks. The juices of the latter are then sucked and the dry body left behind. They are among the few insects that eat such hairy Caterpillars as the Tussock Moth, Fall Webworm, Tent-caterpillar and others, and of course, should be preserved.

In the Southern and Southwestern States there is one species of Assassin Bug that is decidedly obnoxious to mankind. This is known as the "Big Bed-bug," which is found in the sleeping-rooms of mankind where it sucks human blood. Belonging to this Family is the Banded Soldier-bug, (*Milyas cinctus*), which is of well known value to farmers as it eats all kinds of insects, readily attacking potato beetles, especially the soft larvae and numerous other destructive pests. It is orange yellow with numerous black bands crossing its legs and antennae. Whenever any insects are seen of the general type here described or figured the husbandmen should try to ascertain for certainty whether they be friends or foes and not place the death sentence upon them until they prove to be the latter. Give them the benefit of the doubt as they are liable to be decidedly beneficial, and are necessary in the plan of Nature in holding in check the many parasites which afflict mankind or his property.

Family XIII. Nepidæ. The Damsel Bugs. Pl. IX, Fig. 8.

"We have called the members of this Family "Damsel Bugs,' for want of a better name, 'little girl' being the meaning of 'Coriscus,' the scientific name of the most common genus."— *Comstock.*

The Damsel Bugs are common in this State where they are often found hiding among the flowers and foliage of plants where they capture small insects. Their habits are similar to those of the Assassin Bugs, and they are consequently beneficial and worthy of

preservation. Some species are particularly valuable in destroying the Leaf-hoppers which are injurious to grass and foliage plants.

Family XIV. Phymatidæ. The Ambush Bugs. (Plates VI, *a;* and IX, 9.)

The bugs of this beneficial family are recognized by their very thick femora or thighs of the front legs, and by the widened abdomen or posterior part of the body. These legs are especially adapted for grasping their prey, which they take by lying in concealment, especially in flowers where they are able to capture the insects which are attracted to such places.

One of the most common species of this Family is Wolf's (*Phymata Wolffii*). It is a greenish yellow insect marked with a broad black part across the expanded abdomen. It is able to capture and kill large insects, even as large as Cabbage Butterflies, Honey Bees, and Wasps, although itself not more than half as large as the Honey Bee. Its very efficient poison in its beak enables it to do this, as it paralyzes its victim at once. We have had this insect sting us by inserting its beak between the fingers, and while the pain is sharp and severe at the time, it is not especially dangerous. We have found it feeding upon various kinds of insects, including the Plum Curculio and House-fly. We have in our collection a specimen of the Common House-fly upon which we last summer found two specimens of this species of insect feeding. It is thus sufficiently beneficial to justify study and recognition and preservation.

Family XV. Aradidæ. The Flat Bugs. Plate IX, 9.

These are given the name "Flat Bugs" as they are so flatened or depressed that they have the appearance of having been stepped upon. Thy live beneath the bark of decaying logs or the bark of trees, and in such situations their flatened shaps is very important to permit them to crawl into cracks and crevices. They no doubt feed upon fungi and vegetable organisms or juices, and they do not have the strong grasping legs like those which feed upon insects which they must capture.

"Wherever found these insects occur in large numbers, and frequently we find all stages crowded together. The eggs, glistening white in color, are deposited under the bark. It is frequently stated that bed-bugs occur in our pine-woods in a wild condition under the bark, etc., and that whenever a log cabin is erected, this would soon afterwards swarm with bed-bugs. Truth and fiction are here sadly mixed. It is true that such cabins often contain a dense population of various insects parasitic upon man, but they have been brought there by the inhabitants, and did not come with the timber from the woods. In many cases, when the writer asked for proof, such insects as belong to this Family were sent to him

as examples of them. They resemble bed-bugs in many ways, especially in their earlier and unwinged stages, but a trained eye can readily detect the very great difference between the two. Two species are mostly commonly found in and about log cabins. One is black, as flat as the genuine bed-bug, and just as in-active during the day." (Minn. Bulletin No. 69.)

Family XVI. Tingitidæ. The Lace-bugs. Plate IX, 11.

The insects of this Family are given the common name "Lace-bugs" because they appear to be covered or draped in a most delicate lace, which forms the veining of the wings as well as covering other parts. They may be recognized at once by this gauze-like covering resembling fine white brussels net. They are of very small size, rarely being more than one-fourth inch in length and feed upon vegetation, being generally found on the undersides of plants, especially bushes and trees, where at times their numbers may be so great as to cause injury. Fortunately, they are not found upon cultivated plants as much as the uncultivated, one species being in countlesss numbers on the leaves of the sycamore tree where they also pass the winter beneath the loose bark of the tree. We have found them in great numbers under the leaves of the sweet birch or fragrant birch, which is found on the mountainsides of this State. They are often so abundant in August as to cause the leaves to turn brown. Another species attacks the hawthorn, while another species may at times be found on the leaves and flowers of the grape in such numbers as to do considerable damage. This, however, is rare, but when they do occur in such numbers they should be sprayed with contact insecticides like Kerosene Emulsion or Whale Oil Soap, such as is recommended for plant lice and young scale insects. Other plants that are attacked are different species of oaks, the butter-nut, and the cotton plant of the South, beans and even the common pigweed is attacked by one species belonging to this Family. The latter may also attack beets and other cultivated plants. Clean culture is important in combating any kinds of insects that may become numerous and afflict injury, as the destruction of rubbish and trees by fire removes the winter shelter in which this would find concealment, and thus the bugs are decreased.

Family XVII. Acanthiidæ. The Bed-bugs and Flower-bugs. Pl. IX, 12.

It is rather remarkable that the double common name of "Bed-bugs and Flower-bugs" should be given to this Family, especially as the two groups or sub-families are so diversified in habits and economic features. However, in natural history the characteristics that are used in classification are those which are structural or anatomical, and the Acanthiidæ are distinguished from all other

bugs by the four-jointed antennæ, the three-jointed beak and the wings when present with the base or front margin separated with a suture and called the embolium (Fig. I.)

To the Family Acanthiidæ belong the Bed-bugs and closely related insects, which may have wing pads, but do not have fully developed wings. These are parasites or pests upon mankind or warm-blooded animals, birds, etc., although different species inhabit different animals, and those which attack mankind do not infest other creatures, neither are the species which live upon Swallows, Bats, etc., carried by them to human beings.

The Bed-bug is too well known to need description, for as Prof. Lugger says, "Some persons claim they have never seen these parasites. This means that they have either been very fortunate, or that they do not use their eyes or their nose, as bed-bugs are found wherever man has made a home for himself. It is a mooted point whence they came originally, but this, although interesting, makes but little difference at present, as they are now everywhere. * * We see that, being a parasite, and no longer living a rambling existence like other bugs, but being a sort of domesticated animal, it has lost its wings, these being no longer required, and it possesses simply rudiments of them. These look like a little chitinous flap on each side behind the thorax. The adult bugs, as well as the younger ones, are well adapted to enter narrow cracks, having a very flattened shape, and in such shelters they hide during the day, being active only at night. During spring they deposit about fifty white and oval eggs, 1.12 mm long, in the joints of bed-steads, cracks in walls, under loose wall-paper, but especially near iron, be this an old nail in the wall or the hooks that are used to fasten the bed-stead together. These eggs are very beautiful objects; they are terminated by a cap, which is removed by the escaping young bugs. These latter possess the color of innocence, being white and almost transparent; they look, in shape, very much like the old ones, and are only a little broader in comparison, and have stouter feelers. As soon as they can attack a victim they become round and resemble a minute globule of blood. Imbibing blood whenever they have an opportunity, they quickly grow, and after moulting several times, they reach their adult and sexually mature condition. The organ by which they obtain blood is a sucking tube or haustellum. This is composed of two half-cylindrical side-pieces, analogous with the labium and labial palpi, and enclosed in this tube are four sharp and pointed lancets, the transformed mandibles and maxillary palpi."

There are from two to four generations of this pest in this State, and where houses are kept warm all winter there may even be a greater number. It requires about eleven weeks for the bugs to

undergo their complete life cycle from egg to adult. They hibernate or pass the winter in the adult stage and stand severe freezing without death. The bites are very irritating not so much on account of the puncture by their beaks as by the injection of poison. The irritation can be partially allayed by washing the bitten parts with ammonia or with a paste of soda and water. They are known to live at least six months without food, and it is probable that one full feeding is enough to bring the insect to maturity, although under normal conditions certainly it feeds several times durinig its life time.

"We have a large number of remedies against this insect. Cleanliness is of course the best preventive. Yet with all care bed-bugs can and will enter houses, because they are so readily carried with trunks, etc., from infested places, and if they once find a home, they are on account of their form, which is well adapted for hiding, and their capacity for fasting, not readily driven away. The free use of benzine, or of kerosene, sprayed with a hand atomizer into all suspected cracks, will kill all insects, including the eggs, with which the fluid actually comes in contact. This spraying has to be repeated from time to time, and if carefully and thoroughly done, the bed-bugs have no chance to exist in such bed or rooms. If we paint the cracks in a bed-stead or wall, the ends of the slats, and all other suspected places, with one ounce corrosive sublimate dissolved in a half-pint of alcohol and one-fourth pint of oil of turpentine, we have an excellent remedy. All remedies are best applied in early spring, so as to kill all the old hibernating females before they have deposited eggs.

While traveling it is well to remember that bed-bugs are active only during the night and that they abhor daylight. So, if forced to sleep in a bed suspected of containing such unwelcomed inhabitants, it is wise to permit the lamp to burn all night."

Prof. Comstock says, "The means commonly employed to destroy this pest is to wet the cracks of the bedstead and other places in which it hides with corrosive sublimate dissolved in alcohol. This is sold by druggists under the name of bed-bug poison. As this substance is a virulent poison, it should be used with great care. A safer substance to use in Pyrethum. In case of a badly infested room it should be thoroughly cleaned, fumed with sulphur, the walls re-papered, kalsomined, or whitewashed, and the woodwork repainted. In traveling where one is forced to lodge at places infested with this insect, or by fleas, protection from them can be had by sprinkling a small quantity of Pyrethrum, (Insect powder), between the sheets of the bed on retiring.

The best possible remedy for these pests is fumigation with Hydrocyanic Acid Gas. We have mentioned the results of our ex-

stems of plants or extending through bark and wood, and it is well for the person who has the care of plants to watch for such slits, open them carefully and if the eggs of such insects be found in them cut them off and destroy them. The egg state is the form in which some of the species pass the winter, and consequently burning and pruning at such time is effective in getting rid of them.

One of the very beneficial insects belonging to this Family is known as the Glassy-winged Soldier-bug (*Hyaloides vitripennis*). This is a very beautiful insect with small head and large projecting eyes, wings flat elliptical, color yellowish white, with a red or black band across the wind-covers. The length is about two-thirds of an inch. It is commonly found devouring the Leaf-hoppers on grape vines, and also the lice known as the leaf form of the Grape Phylloxera. The young bugs even enter the galls on berry plants and destroy these pests. Grape growers should learn to recognize their value and preserve them. It is only our regret that we have not time or opportunity at this time to publish colored plates of these insects, showing natural size and natural colors. Nothing would be of greater use or benefit to our citizens, and it will be done when the popular demand becomes strong enough.

Family XIX. Pyrrhocoridæ. The Red-bug Family.

The Red-bugs are rather strong, heavy bugs, generally black, brown or red in color, although we hasten to say that all bugs with red colors do not necessarily belong to this Family. It is here that we have the Cotton-stainer (*Dysdercus suturellus*), which gives such a red stain to the cotton when crushed by the cotton pickers, and is consequently a great nuisance to the cotton pickers in the cotton fields. They also cause considerable damage by attacking the cotton plants, and sucking the juices. They also puncture the rinds of oranges, and cause them to decay and drop. There is one species known as the Large Red-bug (*Largus succinctus*) found in this State, which is beneficial as it feeds upon other insects and have been known to do much good in California by eating the destructive Cottony Cushion Scale, which once so seriously threatened so many kinds of bushes and trees in this State.

Family XX. Lygæidæ. The Chinch Bug Family. Pl. IX, 14 and 15.

This is a large Family of small insects. There are about one hundred and fifty species known to occur in the United States. The characteristic features of this Family are easily determined by the veins of the wings, but this Bulletin is prepared for the practical citizens who should know the various kinds of insects around him in order to preserve his friends and destroy his foes, and not for the scientific student of entomology. The latter is referred to Com-

stock's Manual For the Study of Insects, published by the Comstock Publishing Company, Ithaca, N. Y. This is not too technical for the intelligent reader and contains keys and illustrations by which it is possible to ascertain with certainty the Families and many of the species of nearly all insects found in this State.

The Chinch Bug belongs to this Family. Until recently there had been more literature written about this insect than any other, but within recent years the San José Scale has passed to first place in the attention given insects by economic entomologists. This insect is undoubtedly the most destructive species of Heteropterous insect known to mankind, although its attacks have been most serious in the Mississippi Valley, and it does not usually occur in any great extent in this State.

It is a small bug measuring one-sixth of an inch in length, black with white wing-covers, and on the middle outer or front margin of each there is a black spot. There are two generations per year and the adult insects pass the winter concealed in rubbish. The young or nymphs are red, feeding at first upon the roots, then they attack the stalks and leaves of plants, injecting their poison and sucking out the sap and cause very serious injury to grains, grasses, corn, etc. We have seen them so abundant that a wash pan full could be shaken from one corn stalk. No satisfactory and easily applied remedy for killing these insects has been discovered, but Prof. Snow, of Kansas, claims to have had considerable success in introducing a contagious disease by artificial means among these pests. However, some other States, especially Illinois, report that after most careful efforts, they have failed to give relief by the inoculation of this disease.

Several species of Lygaeids are found in this State, feeding in meadows and open woods and some fly to lights at night. The largest and most beautiful is the Milk-weed Bug (*Onocopeltes fasciatus*), which is about two-thirds of an inch in length (Pl. IX, 15.) The upper surface is orange with black bands, and it is found at times rather abundantly upon milkweed. Since it attacks only weeds it is not of economic importance.

To this Family also belong a number of bugs of various species, some of which are called "False Chinch Bugs," and many of which have been mistaken for the "True Chinch Bugs," and sent to us for this pest. However, we must acknowledge that we have never received the genuine Chinch Bug (*Blissus leucopterus*) from this State, although we have had reports of its occurrence. It is of such as these "False Chinch Bugs" that Prof. Lugger says, "These bugs are at times exceedingly numerous and not infrequently cause alarm by their presence, as farmers are apt to conclude that they are the injurious Chinch Bugs. Yet they are perfectly harmless feeding

upon many kinds of low-growing weeds. They possess another point in their favor, as they have been seen to actually eat the farmers' great enemy, the "True Chinch Bug." The one properly called the "False Chinch Bug" is known by the scientific name *Nysius angustatus*, and is a general feeder, sometimes occurring in such numbers as to be injurious. It may attack the leaves of the grape vine, strawberry, apple, turnip, radish, beet, lettuce and other plants. However, it seems to avoid the grasses and cereals, which are among the chief food of the True Chinch Bug. The potato leaves infected with these insects show little rusty holes wherever the poisonous beak as been inserted. The remedies are the same as for the Plant Bug discussed on a previous page, clean cultivation and burning of all trash should be observed. Pyrethrum, Persian Insect Powder and Kerosene Emulsion will give good results against such pests.

Family XXI. Berytidæ. The Stilt-bugs. Pl. IX, 16.

There is but one species of this Family in Pennsylvania, and as this feeds upon the undergrowth of oak wood, it is not of economic importance. The name of the Family is given on account of the extreme slender body and long legs, somewhat resembling the Marsh-treaders described on a preceding page.

Family XXII. Coreidæ. The Squash-bug Family. Plates VII, VIII, and IX, 17.

This is one of the largest and most important Families of the Heteroptera. It is recognized in having the beak four-jointed, the front legs fitted for walking, the wing-covers or front wings without a cuneus, (See Plate I), ocelli or single eyes in addition to the compound eyes, and the head without a cross suture in front of these eyes.

The members of this Family feed upon either vegetation or animal tissue, according to the respective species. For example, there is one species found extensively on box elder trees in some parts of th county, and is consequently known as the Box-elder Bug. Belonging to this Family is the insect known as the Stinging Squash-bug or Large Squash-bug (*Anasa tristis*). Plates VII and VIII. This insect is fully described in our Bulletin No. 96, on "Insects Injurious to Cucurbitaceous Plants." It lays very large eggs which become rather dark brown in color and scatters them in irregular rows over rather large patches on leaves of squash, cucumber, pumpkin, and similar plants. It is advisable to protect your plants from them by using cloth covers or spread around them lime or land plaster saturated with Kerosene or Turpentine to repel the pests. Also plant more seed than is needed in order to keep their attacks from being concentrated upon a few choice plants, and by fertilization and clean culture

stimulate the growth of the plants, and clean up all rubbish or debris in which these pests pass the winter in their adult form. It is also advisable to pick the bugs by hand and drop them into a pan of oil and also watch for their eggs under leaves and pick them off and crush them. We have had good success trapping these pests with three corn-cobs placed lengthwise in a pile. They will also find concealment under poles and bark on the ground. For the later and choice squash, such as the Hubbards, it is advisable to plant earlier cucurbits to trap the insects.

There are other species of this Family attacking melon vines, sugar beets, the fruit of the cherry and other plants. They can be destroyed by spraying with strong Kerosene Emulsion, or Whale Oil Soap, one pound in five or six gallons of water. There is one species, *Corizus*, which attacks the Cottony Cushion Scale and other scale insects.

Family XXIII. Pentatomidæ. The Sting-bug Family. Pls. VI and IX, 18-21.

These large broad, five-sided bugs with the nauseous odors are well known to nearly all persons. In eating berries one often detects their unpleasant flavor, and it is these which generally give the unpleasant odor to individual berries against which they have been pressed. Their odor is given out at will and when they are squeezed they usually give off this unpleasant odor. However, is should be said that there are many other bugs that give off offensive and protective odor besides those which belong to this Family.

The Pentatomids have five-jointed feelers or antennæ, their body is short, broad and rather thick, and they have a very large scutellum or triangular piece or beak. Some of them are predaceous, others are strictly vegetarians, while others are both. There is one species that is especially known to feed extensively upon potato beetles, and another has been seen to attack and kill the plum curculio. The latter (*Podisus*) is shown in our illustration Fig. b, Plate VI.

Belonging to this Family is the Harlequin Cabbage Bug, which is also called the Calico Bug, owing to its bluish, black, yellow and orange colors. It feeds upon cabbage, turnips and other cruciferous plants and is found in the southwestern part of this State and from that region southward and westward to Arizona. It is very destructive to the plants of the Mustard Family, and the best way to destroy it is to plant earlier plants or sow mustard to act as a trap crop, and when this is badly infested spray it with Kerosene. The bugs can also be trapped by placing cabbage leaves on the ground in early spring, and then kill them by hand-picking. Another species with narrower body that belongs to the Pentatomids is injurious to grasses, while another species has been known to afflict considerable injury upon asparagus plants and the young heads of wheat. One

species is known to feed upon the larvæ of the Cotton Moth of the South, and also upon the sap of growing wheat. We have seen the narrow green Pentatomid attack and kill the Fall Webworm in numbers. Another known as the Angular Gray Tree-bug is beneficial in its habits, although at times it may suck the sap from young apple trees.

Family XXIV. Cydnidæ. The Burrower Bugs. Pl. IX, 23.

This is a small Family of Bugs that are found burrowing in sandy places or beneath sticks and stones, and are not known to be of special importance. They are rare and their habits have not been studied to any great extent.

Family XXV. Corimelænidæ. The Negro-bugs. Pl. IX, 22.

This is a Family of small black bugs that are so rounded on the back or the dorsal side as to appear like beetles. There is but one genus, yet some of these may occur in numbers upon certain fruit-bearing plants and upon potato vines, where they cause the leaves to wilt by puncturing them. Their odor is very nauseous, as it is one of the bugs that readily lends its offensive odor and flavor to berries and other fruits.

Family XXVI. Scutelleridæ. The Shield-back Bugs.

This is a Family of small rare bugs of comparatively small size which feed upon plants and are turtle-shaped, with a very large scutellum. They resemble the Negro-bugs, but differ from them in not having a row of grooves at the side of the scutellum to receive the edges of the wing-covers.

SAVE THE LILAC BUSH!

Among the old-fashioned familiar plants often seen in door-yards, particularly in the country, none is more common nor more worthy of preservation than the good old Lilac. Its flowers come the earliest and remain for a long time, and for us who were reared upon the farm its associations have been such that the sight of its flowers are always recalling to us tender memories and recollections.

The Lilac is a very hardy shrub and so easily grown that but little care is required to keep it growing year after year and retain its beauty and vigor. As with all plants the process of producing seed

is very exhaustive upon its vigor, and for this reason it is better to clip off the bunches usually forming seed buds at this time of year, or after the flowers fall the sod around the bushes should be turned, weeds pulled and some commercial fertilizer or mulch or manure added.

The Lilac can be made to bloom twice per year, or in other words to put out a new set of leaves and also flower buds in the fall, by stripping it of its leaves the latter part of June. This, however, means that the plant is forced to double duty, and where this is undertaken fertilizer or plant food should by all means be added to the soil and cultivation and watering should also be observed, and with proper care the vitality of the plant may not be impaired by forcing it to produce a fall crop of blossoms. Few shrubs are as free from fungus diseases or insect pests as is the Lilac. Only one species of insect attacks it seriously, but that is its arch enemy and foe to the death. The Oyster-shell Scale is to be found to-day on by far the greater number of Lilac bushes growing in the State of Pennsylvania, and the chances are two to one that it is in destroying numbers upon the bushes of every person who reads this article. There is no plant that is worse infested with Oyster-shell Scale and none that it kills sooner. The only insect which frequently attacks it, and consequently the only one for which it is to be treated, is this Oyster-shell Scale. Now is the time of year, and persons who care to preserve their shrubbery should lose no time, but at once prepare a solution of soap suds, using one pound of common laundry soap to not more than three gallons of water, or one pound of Whale Oil Soap in six gallons of water, or eight or ten per cent. Kerosene Emulsion, and give their plants a thorough spraying or washing with this solution. Soap suds left after laundry or washing is very good for killing the Oyster-shell Scale if a little more soap be added to it so as to be sure and have it very strong. The eggs of the Oyster-shell Scale hatched in the vicinity of Harrisburg the third week of May, and a little further north at a date a few days later, and the young pests are very delicate and easily killed if treated at once by a thorough spraying of the strong soap or Kerosene Emulsion.

THE SEVENTEEN YEAR CICADA.

The so-called Locust or Seventeen-year Cicada has appeared from Scranton and Williamsport to Altoona and eastward to Reading, as was predicted in former numbers of this Bulletin, notwithstanding the contradictions that were immediately expressed by persons in the Southern and Southeastern parts of the State where the Cicada was present in 1902. They could not understand how it was possible that this insect could have a true periodicity of seventeen years and

also appear in some of the Southern and Southeastern counties of the State at an interval of only four years. This is due to the fact that those appearing in 1902 were not in any way related to the brood or swarm that appears this year, and that in a few sections of the State, as from the Northern part of Cumberland county to Berks county, the Cicada or Locust appeared then, and another and distinct brood appears this year.

We must confess that we are pained that so much utter nonsense about Locusts has been published recently in the local papers in some portions of this State. One editor relates how they chased the workmen from a mine, and another gravely declares that they stung a man about the head and face until his life was despaired. We take this opportunity to allay the fears of the public and to state that these insects are harmless to human beings and do not bite or sting any person under any circumstances. We have lately handled thousands of them that were alive and active, and our little boy seven years of age has repeatedly had over a score of them in his hands at one time without the slightest danger. They are more harmless than house flies as far as concerns their direct injury to mankind, and it is only by piercing the small trunks and branches of trees that they inflict any injury to the property of mankind.

There is a common superstition that when there is a "W" on their wings there will be war, but as a W-shaped mark is present on the wings of all individuals of the common variety and "wars or rumors of war" are known at some place on the face of the earth at all time it is a very easy matter to verify this accidental entomological prophesy.

These insects do not destroy crops such as grain, and are not related to the consuming Locusts of Egypt, which were no doubt Grasshoppers, as were the destructive Kansas "Locusts" of some years ago.

Proper preventive measures for these pests should have been taken long before they appeared, as we published in our previous Bulletins, but now that they have appeared, especially in the wooded districts, little can be done to prevent their injury excepting to trim as closely as possible all limbs that are punctured, taking special care to cut away as many of the injured branches as can well be removed.

There is a popular although an erroneous belief that the reason the Cicadas are seventeen years from generation to generation is that they spend eight years boring down into the ground, take one year to turn around, and eight more years to complete the return journey to the surface. This, of course, is absurd. The truth is that the eggs are laid by the female in growing twigs, and this insures food for the young by their dropping on the ground over living

roots, during the month of July, where they enter the soil far enough to find living roots on which they remain sucking the juices until their development is completed. Where they are prevented from entering the ground, either by clipping and burning all twigs containing their eggs, or by sprinkling the ground with kerosene or a strong soap solution they will not appear at the date for the next generation.

Note:—This Bulletion does not contain a special discussion of insects that are to be destroyed during June and July for the reason that these are fully discussed in our respective Bulletins for these months of last year, and as we have enough copies of each of these issues in stock to meet all demands, persons who need them are requested to write for them, and receive the information which is as reliable at present as it was when published a year ago when published for the same pests during the same season. H. A. Surface, Economic Zoologist, Harrisburg, Pa.

SPECIMENS RECEIVED DURING APRIL, 1906.

Number.	Specimen. Insects.	Date—April, 1906.	Name and Address of Sender.
5377	Apple Aphis Eggs,	2	M. Birth, Fairmount Springs.
5378	West Indian Cockroach,	2	B. Long, Ashbourne.
5383	Bird Lice from Crow,	2	R. M. Creasy, Lightstreet.
5385	(a) Canker Worms, (b) Bucculatrix Cocoons,	2	A. P. Goodwin, Industry.
5386	(a) Scurfy Scale, (b) Aphis Eggs,	3	S. J. McClure, Clark.
5387	(a) Assassin Bug Eggs, (b) Katydid Eggs,	3	J. S. Cutler, Drumore.
5389	Polyphemus Cocoons,	3	Mrs. A. E. Williams, Port Trevorton.
5392	Scurfy Scale,	3	J. Norrie, Dorranceton.
5393	San José Scale,	3	C. A. Wismer, Gratersford.
5394	(a) San José Scale, (b) Scurfy Scale, (d) Aphis Eggs,	3	J. M. Jones, Freemansburg.
5395	(b) Aphis Eggs,	3	C. H. Watson, Newtown.
5398	Rose Diaspis,	4	L. Bosselle, Frankford.
5400	Aphis Eggs,	4	E. C. Frear, Lake Winola.
5401	Aleyrodes vaporariorum,	4	B. Harris, Newtown.
5403	Oyster-shell Scale,	4	J. Long, Summerhill.
5404	Apple-borer Larvæ,	4	W. H. Jenkins, Sheradenville.
5405	Scurfy Scale,	4	F. Haller, Jr., Hollidaysburg.
5406	Magnolia Lecanium,	4	C. F. Laurie, Erie.
5416	Oyster-shell Scale,	5	P. A. Oliver, Olivers Mills.
5417	Scurfy Scale,	5	R. H. Schoemen, Allentown.
5418	Prionus Larvæ,	5	A. J. Schubert, Johnstown.
5420	Oyster-shell Scale,	5	C. A. Morris, Oliveburg.
5421	(a) San José Scale,	5	A. M. Reading, Wrightstown.
5422	(a) Canker Worms Eggs, (b) Young Lecanium, (c) Aphis Eggs,	5	A. D. Frost, Pittsburg.
5431	San José Scale,	6	H. Levers, Easton.
5432	Oyster-shell Scale,	6	J. H. Friday, Vail.
5433	Scurfy Scale,	6	A. A. Arnold, Mechanicsburg.
5434	(a) San José Scale, (b) Scurfy Scale, (c) Oyster-shell Scale,	6	P. H. Peffer, Harmony.
5435	(a) Oyster-shell Scale, (b) Bucculatrix Cocoon, (c) Cecropia Cocoon, (d) Larvæ of Oxwarble (?),	6	W. F. Shafer, Cogan Station.
5436	Oyster-shell Scale,	6	J. W. DeWalt, Parkers Landing.
5437	Scurfy Scale,	6	J. D. Wentling, Greensburg.
5438	Tree-cricket Eggs,	7	W. E. Miller, New Mayville.
5439	Katydid Eggs,	7	C. H. Groff, Berwyn.
5440	Scurfy Scale,	7	T. T. Hileman, Hollidaysburg.
5442	Scurfy Scale,	7	S. Heisel, Queen.
5443	Scurfy Scale,	7	M. E. Shirk, Stevens.
5444	(a) Oyster-shell Scale, (b) Scurfy Scale, (d) Aphis Eggs,	7	C. E. Mansell, Laceyville.
5450	(b) Moths,	9	J. P. Lehman, Coudersport.
5451	Grasshoppers,	9	Clara B. Steele, Lawrenceville.
5452	San José Scale, Scurfy Scale,	9	E. M. Sands, Lebanon.
5453	(a) San José Scale, (b) Scurfy SScale, (c) Oyster-shell Scale,	9	C. C. Ziegenfuss, Easton.
5454	Oyster-shell Scale,	9	H. A. Smith, Sunbury.
5455	Scurfy Scale,	9	H. A. Smith, Sunbury.
5456	(a) Oyster-shell Scale, (b) San José Scale, (d) Scurfy Scale,	9	O. G. Mahon, Mill City.
5457	San José Scale,	9	S. F. Moyer, Alexandria.
5458	Scurfy Scale,	9	J. F. McLean, Greenville.
5460	Bird Lice from Quails,	5	Dr. Kalbfus, Harrisburg.
5461	(a) Cynip Galls on Wild Rose, (b) Cynip Galls on Blackberry, (c) Moth Galls on Goldenrod,	9	R. P. Marsh, Chester, N. J.
5465	(a) Cecidomyia, (b) Flies,	9	C. Anderson, Harrisburg.
5470	(d) Cecropia Cocoon,	10	R. B. Simpson, Warren.
5471	San José Scale,	10	A. P. Goodwin, Industry.
5472	San José Scale,	10	H. B. Worrell, Philadelphia.
5474	Scurfy Scale,	10	S. Dougherty, Belle Vernon.

Specimens Received During April—Continued.

Number.	Specimen. Insects.	Date—April, 1906.	Name and Address of Sender.
5475	Scurfy Scale,	10	Mrs. L. H. Pierce, Embreeville.
5477	San José Scale,	10	J. H. Ledy, Marion.
5479	(c) Flea from Pine Vole,	11	R. B. Simpson, Warren.
5480	Eyed Elater,	11	M. W. Moss, Benton.
5481	(a) Canker Worms, (b) Tussock Moth Eggs,	11	J. H. Thompson, Ellwood City.
5482	Oyster-shell Scale,	11	W. H. Deveraux, Wilcox.
5483	Oyster-shell Scale,	11	W. J. Young, Springville.
5484	(a) San José Scale,	11	A. Gerhart, West Fairview.
5486	(a) Cecropia Cocoons, (b) Promethea Cocoons, (c) Katydid Eggs, (d) Rose Diaspis,	12	J. T. Blake, Fox Chase.
5487	Young Lecanium,	12	F. A. Newcomer, Milton.
5490	(a) Scurfy Scale, (b) Oyster-shell Scale, (c) Aphis Eggs,	12	Mrs. J. T. Williams, Laceyville.
5491	(a) Scurfy Scale,	12	A. Yeany, New Mayville.
5493	San José Scale,	12	G. H. Jenkins, Gwynedd.
5494	(a) Oyster-shell Scale, (b) Scurfy Scale,	12	Dr. P. Herman, Kratzersville.
5496	(a) Oyster-shell Scale,	12	J. Snyder, Reynoldsville.
5498	(a) Scurfy Scale, (b) Oyster-shell Scale,	12	J. C. Curfman, Cassville.
5501	Lady Bugs (P. misella),	12	A. G. Wanner, Ephrata.
5502	Scurfy Scale,	12	D. A. Nelson, McConnellsburg.
5506	(a) Bird Lice from Purple Grackle,	13	M. H. Pfleager, Mechanicsburg.
5507	(a) Oyster-shell Scale, (b) Scurfy Scale,	13	J. T. Campbell, New Bethlehem.
5508	(a) Oyster-shell Scale, (b) Aphis Eggs,	13	G. Biles, Ulster.
5509	Lecanium (young),	13	W. G. Wimer, Montoursville.
5511	San José Scale,	13	J. E. Smith, Ridley Park.
5512	(a) Oyster-shell Scale, (b) Aphis Eggs,	13	J. C. Colegrove, Gaines.
5514	Bird Lice from Crow,	13	O. N. Byers, Newtonburg.
5519	San José Scale,	13	C. A. DeLong, Mont Alto.
5520	Oyster-shell Scale,	13	H. W. Wagaman, Kempton.
5522	Aphis Eggs,	14	M. C. Brightbill, Marsh Run.
5523	Canker Worm Eggs,	14	J. G. McBride, Conneautville.
5524	(a) Scurfy Scale, (b) Oyster-shell Scale,	14	A. B. Shope, Saltillo.
5525	Resplendent Shield-bearer Cases,	14	C. F. Laurie, Erie.
5528	Scurfy Scale,	14	J. M. Craig, Fountain Springs.
5529	San José Scale,	14	I. Brake, Edenville.
5530	San José Scale,	14	G. P. Barclay, Industry.
5531	(a) San José Scale, (b) Oyster-shell Scale,	14	Prof. C. L. Thornburg, S. Bethlehem.
5535	San José Scale,	16	A. U. Black, Annville.
5536	Oyster-shell Scale,	16	B. Snyder, Meadville.
5537	Putman's Scale (?),	16	J. E. West, Elizabeth.
5538	Oyster-shell Scale,	16	J. W. B. Schall, Jeannette.
5539	San José Scale,	16	J. B. Runyan, McConnellsburg.
5540	(a) Oyster-shell Scale, (b) Aphis Eggs,	16	B. O. Smith, Burlington.
5541	(b) Wooly Aphis,	16	W. T. Gilkerson, Apollo.
5542	(a) Seven Promethea Cocoons, (b) Two Cecropia Cocoons,	16	F. Hatch, Scranton.
5543	(a) Cecropia Cocoon, (b) Promethea Cocoons,	16	J. A. Rice, Alinda.
5548	Moths,	16	L. H. Goodenough, Girdland.
5550	(a) Scurfy Scale, (b) Tussock Moth Eggs,	16	J. Y. Ellis, Montgomery.
5551	Oyster-shell Scale,	16	J. A. Hand, Moosic.
5552	Euonymus Scale,	16	H. B. Worrell, Meadow Brook.
5557	San José Scale,	17	E. A. Weimer, Lebanon.
5558	(a) Oyster-shell Scale, (b) Lecanium,	17	W. Ely Stony Run.
5559	Scurfy Scale,	17	D. H. Miller, East Orange, N. J.
5560	Pear Sawflies,	17	Mrs. H. A. Brightbill, Marsh Run.
5564	Scurfy Scale,	17	G. S. Stone, New Freedom.
5565	Scurfy Scale,	17	D. L. Thomson, Tunkhannock.
5567	Oyster-shell Scale,	17	F. J. Kooser, Somerset.
5568	Bird Lice from Snipes,	17	Dr. Kalbfus, Harrisburg.
5571	Rose Diaspis,	18	Dr. J. Aulde, Philadelphia.
5572	Scurfy Scale,	18	M. M. Scott, New Sheffield.
5573	Cecropia Cocoon,	18	C. F. Tuttle, Burlington.
5577	San José Scale,	18	F. Haller, Jr., Hollidaysburg.
5578	(a) San José Scale, (b) Oyster-shell Scale,	18	G. B. O. Felty, Millersville.
5583	San José Scale,	19	G. W. Michaels, Baldmount.
5584	Scurfy Scale,	19	A. G. Shaffer, Shelocta.

Specimens Received During April—Continued.

Number.	Specimen. Insects.	Date—April, 1906.	Name and Address of Sender.
5586	(a) Scurfy Scale, (b) Oyster-shell Scale, (c) Aphis Eggs,	19	S. J. McClure, Clark.
5587	Oyster-shell Scale,	19	A. S. Stover, Aaronsburg.
5590	(b) Oyster-shell Scale, (c)) Female Canker Worms, (d) Canker Worm Eggs,	19	W. Bruner, Carrolltown.
5592	Scurfy Scale,	19	N. Grove, Lemont.
5596	Pea Weevils,	19	Mrs. T. Erwin, Woodland.
5597	Oyster-shell Scale,	19	J. K. Wingert, Chambersburg.
5602	Oyster-shell Scale,	20	J. S. Colyer, Perulack.
5603	Oyster-shell Scale,	20	G. Shannon, Prospect.
5604	Scurfy Scale,	20	H. D. Miles, Wallaceville.
5607	(a) Water Beetles, (b) Carrion Beetles, (c) Moths,	19	C. Anderson, Harrisburg.
5608	Water Beetles,	20	E. Meals, A. Phelps and C. Greenawalt, Harrisburg.
5609	(a) Scurfy Scale, (b) Oyster-shell Scale,	20	Frank Beemiller, Bedford.
5610	Empty Pentatomid Eggs,	20	Prof. Henschen, Harrisburg.
5612	(a) Cecropia Cocoon, (b) Polyphemus Cocoons,	21	C. E. Denniston, Okome.
5614	(a) San José Scale, (b) Scurfy Scale,	21	T. Stoneham, Plymouth.
5615	Lecanium,	21	J. W. Huling, Pine Station.
5617	Lecanium,	21	Mrs. M. A. Ramsden, Fort Washington.
5623	(a) Scurfy Scale, (c) Oyster-shell Scale,	23	H. L. Griffith, Canonsburg.
5624	Scurfy Scale,	23	Field Force Pump Co., Elmira, N. Y.
5625	Dragon Fly (E. heros),	23	L. D. Palmer, Blacklick.
5626	(a) San José Scale, (c) Katydid Eggs,	23	I. F. Zook, Ronks.
5628	Giant Water Bugs,	23	C. Anderson, Harrisburg.
5629	Insects,	23	C. Anderson, Harrisburg.
5630	Imperialis Pupa,	23	C. J. Harwood, Marion.
5631	Bird Lice from Bittern,	23	J. G. Cook, New Alexandria.
5633	Promothea Cocoons,	23	C. P. Gearhart, Danville.
5634	Lepidoptera Eggs,	23	M. G. Baker, Mechanicsburg.
5635	San José Scale,	24	G. W. Hain, Callery.
5637	Katydid Eggs,	24	W. J. Lyons, Gans.
5638	Cynip Gall on Blackberry,	24	F. W. Bossard, Hummelstown.
5639	Cecropia Cocoons,	24	J. F. Beecher, Kerrsville.
5640	Oyster-shell Scale,	24	J. Lochrie, Windber.
5642	Oyster-shell Scale,	24	F. A. Moore, Reynoldsville.
5643	Oyster-shell Scale,	24	W. C. Welliver, Unityville.
5644	(a) San José Scale, (b) Scurfy Scale,	24	E. W. Myers, Wilkes-Barre.
5645	Dogwood Cecidomyia Galls,	24	W. K. Jamison, Greensburg.
5650	Scurfy Scale,	24	F. O. Schadel, Klingerstown.
5653	Work of Cicadas,	24	E. G. Bain, Carversville.
5654	Collection of Lepidoptera and Coleoptera for Determination.	24	W. C. Barbour, Sayre.
5656	San José Scale, Oyster-shell Scale,	24	F. A. Gutschall, Carlisle Springs.
5657	Cecropia Cocoons,	25	D. W. Bard, Mt. Airy.
5661	San José Scale, Scurfy Scale,	25	G. C. Mayer, Elizabethtown.
5663	Oyster-shell Scale,	25	J. W. Hause, Newfoundland.
5665	San José Scale,	25	E. W. Walhay, Bendersville.
5666	Peach Borer Larva,	25	C. Anderson, Harrisburg.
5667	Oyster-shell Scale,	26	R. C. Atwood, North Towanda.
5673	Polyphemus Cocoon,	26	H. H. Wert, Weissport.
5674	Scurfy Scale,	26	D. M. Summers, Entriken.
5677	Scurfy Scale,	26	O. Rice, New Bloomfield.
5679	Scurfy Scale,	26	W. K. Shissler, Pottsville.
5683	Oyster-shell Scale,	27	W. C. Woods, New Castle.
5692	Lady Bug (M. maculata),	28	T. B. Beecher, Kerrsville.
5693	(a) Ground Beetle, (b) Rove Beetle,	28	L. Martin, McCall Ferry.
5695	Tiger Beetle (C. 6-guttata),	28	J. W. Fox, Mt. Pleasant.
5696	Scurfy Scale,	28	P. M. Rush,, Sycamore.
5698	(c) Promethea Cocoons, (d) Cecropia Cocoons,	30	R. W. Wehrle, Indiana.
5699	(a) San José Scale, (b) Scurfy Scale,	30	T. Tewell, Artemas.
5701	(a) Tulip Lecanium,	30	M. C. Brightbill, Marsh Run.
5702	Oyster-shell Scale,	30	M. G. Johnson, Grass Flat.
5703	Oyster-shell Scale,	30	C. E. Hoyt, Sabula.
5705	Tree Hopper Eggs,	30	J. Waugh, Washington.

Specimens Received During April—Continued.

Number.	Specimen. Insects.	Date—April, 1906.	Name and Address of Sender.
5708	(a) Oyster-shell Scale,	30	C. D. Dayton, Birchardville.
5711	Book Lice,	30	Mrs. A. S. Hostetter, Lancaster.
5712	(a) Tiger Beetles, (b) 17-year Cicada Nymphs, (c) Ground Beetles,	30	R. D. Spencer, Williamsport.
5714	Oyster-shell Scale,	30	O. Shilke, Lineboro.
5715	(a) Scurfy Scale, (b) Oyster-shell Scale,	30	B. E. Border, Clarington.
5716	Crane Flies,	30	J. G. Krichbaum, Chambersburg.
	Invertebrates not Insects.		
5382	Crustacea,	2	Prof. Henschen, Harrisburg.
5386	(c) Red Mites,	3	S. J. McClure, Clark.
5394	(c) Red Mites,	3	J. M. Jones, Freemansburg.
5395	(a) Red Mites,	3	C. H. Watson, Newtown.
5399	Red Mites,	4	P. S. Duncan, Hollidaysburg.
5421	(b) Red Mites,	5	Anna M. Reading, Wrightstown.
5430	(b) Centipedes,	6	Dr. I. H. Mayer, Willowstreet.
5431	(b) Red Mites,	6	H. Levers, Easton.
5444	(c) Red Mites,	7	C. E. Mansell, Laceyville.
5452	(c) Red Mites,	9	E. M. Sands, Lebanon.
5455	(b) Mites,	9	H. A. Smith, Sunbury.
5456	(c) Mites,	9	O. G. Mahon, Mill City.
5472	(b) Mites,	10	H. B. Worrell, Philadelphia.
5474	(b) Mites,	10	S. Dougherty, Belle Vernon.
5479	(b) Mites from Mice (M. pinetorum)	11	R. B. Simpson, Warren.
5484	(b) Mites,	11	A. Gerhart, West Fairview.
5489	Centipede,	12	B. W. Stennett, Corry.
5490	(d) Red Mites,	12	Mrs. J. P. Williams, Laceyville.
5512	(c) Mites,	13	J. C. Colegrove, Gaines.
5516	(c) Millipedes,	13	R. Jackson, McConnellsburg.
5556	(a) Red Mites,	17	D. S. Kriestruck, Washington.
5582	Red Mites,	19	T. Earle, Steelton.
5623	(b) Red Mites,	23	H. L. Griffith, Canonsburg.
5628	(b) Mites,	23	I. F. Zook, Ronks.
5629	(c) Mite, (d) Millipedes,	23	C. Anderson, Harrisburg.
5668	Wood Tick from Calf,	26	A. L. Kenyon, Columbia Cross Roads.
5683	Red Mites,	27	W. C. Woods, New Castle.
5708	(b) Red Mites,	30	C. D. Dayton, Birchardville.
	Batrachians and Reptiles.		
5429	Rock Snake (S. dekayi),	3	A. Stevenson, Harrisburg.
5430	2 Land Salamanders (P. cinereus),	6	Dr. I. H. Mayer, Willowstreet.
5446	Spotted Salamander (A. punctatum),	6	G. W. T. Warburton, Granville Summit.
5447	Spotted Salamander (A. punctatum).	7	John Grady, Shamokin.
5468	5 Blacksnakes (B. constrictor),	10	J. Fosbeiner, Richland Centre.
5469	Water Snake (N. sipedon),	10	O. P. Satterthwaite, Wawa.
5470	(b) 4 Red Salamanders (S. ruber), (c) Brown Salamander (D. fusca),	10	R. B. Simpson, Warren.
5485	Spotted Salamander (A. punctatum).	12	E. Quintin, Ariel.
5499	Garter Snake (T. sirtalis),	12	H. G. Hain, Lebanon.
5500	Blacksnake (B. constrictor),	12	Anna K. Bewley, Forestgrove.
5513	Garter Snake (T. sirtalis),	13	E. F. Neithamer, Reading.
5516	(a) Water Snake (N. sipedon),	13	R. Jackson, McConnellsburg.
5544	3 Black Snakes (B. constrictor),	16	Anna K. Bewley, Forestgrove.
5545	Garter Snake (T. sirtalis),	16	F. W. Pennell, Wawa.
5546	Black Snake (B. constrictor),	16	H. M. Brightbill, Marsh Run.
5547	Garter Snake (T. sirtalis),	16	E. L. Gallagher, Lansford.
5553	(a) 2 Land Salamanders (P. cinereus. (b) Newt (D. viridescens).	16	O. P. Satterthwaite, Wawa.
5563	2 Land Salamanders (P. cinereus),	17	C. Brubaker, Hooversville.
5574	Water Snake (N. sipedon),	18	L. S. Pearson, Wayne.
5575	(a) Garter Snake (T. sirtalis),	18	R. G. Hull, Lisburn.
5589	(a) Garter Snake (T. sirtalis),	19	R. G. Hull, Lisburn.
5591	Red Salamander (S. ruber),	19	N. S. Brown, Springville.
5596	4 Garter Snakes (T. sirtalis),	19	I. L. Bernicker, Philadelphia.
5598	Spotted Salamander (A. punctatum).	20	N. S. Brown, Springville.
5599	Grass Snake (L. vernalis),	20	H. M. Brightbill, Marsh Run.
5611	Black Snake (B. constrictor),	20	J. Bohn, Lickdale.
5618	(a) Salamander (A. opacum),	21	Mrs. H. A. Brightbill, Marsh Run.
5622	(a) Land Salamander (P. cinereus) (b) Granite Salamander (P. glutinosus.	23	A. J. Shumaker, Blain.
5627	Rock Snake (S. dekayi),	21	N. Wise, Harrisburg.
5629	(b) Land Salamander (P. cinereus).	23	C. Anderson, Harrisburg.
5636	Garter Snake (T. sirtalis),	24	A. Rutherford, Harrisburg.

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REPORT OF PERSONAL EXPERIMENTS.

Summer Experiments for Oyster-shell Scale.

The following report of our experiments for the Oyster-shell Scale gives the results of trials that were made with various insecticides and at varying strengths while the scale were yet young or within about a week, at most, from the time they became fixed. In all cases they had passed the free-moving stage but were only very recently fixed and had not had time to develop such heavy protecting coats as prevent satisfactory application of insecticides to the mature scale of this species.

The young of the Scurfy Scale, and in fact of all other scale insects, can be killed by the same materials, especially those which are shown here to have given us the best results, such as the Whale Oil Soap, but it must be remembered that the older scales are not killed by such materials, and this emphasizes the necessity of watching for the appearance of the young and spraying them at the right time. Where the infested tree or bush is small, very good results can be obtained by painting it by hand with stronger material, if a spray pump be not at hand for spraying purposes.

TABULATION OF RESULTS.

Number.	Date.	Plant.	Strength.	Per cent. pests killed.	Remarks.
	(a) Soap Solution for Oyster-shell Scale.				
1	May 22,.....	Lilac,.....	1 lb. 5 gal. water,	95 to 98	Borax Laundry Soap.
2	May 23,.....	Lilac,.....	1 lb. 7 gal. water,	All.	Whale Oil Soap.
3	May 23,.....	Lilac,.....	1 lb. 10 gal. water,	All.	Whale Oil Soap.
	(b) Kerosene Emulsion for Oyster-shell Scale.				
4	May 22,.....	Lilac,.....	8 per cent., ...	98	Common Coal Oil.
5	May 22,.....	Lilac,.....	6 per cent., ...	98	Common Coal Oil.
6	May 22,.....	Lilac,.....	5 per cent., ...	98	Common Coal Oil.
7	May 23,.....	Poplar,.....	7 per cent., ...	95	Trees very large.
8	May 23,.....	Poplar,.....	9 per cent., ...	95	Trees very large.

The cost of the treatment was in no case more than one cent per gallon for material, and in some that were effective it was only

half that much. By a study of the above statement it is seen that common laundry soap was used in experiments No. 1, and very good results were obtained, although the best results were from the use of the Whale Oil Soap. It is interesting to note that using this soap in a solution of water as dilute as one pound of soap in ten gallons of water gave as good results as could be obtained. In experiments Nos. 7 and 8 the trees were very large, as they were poplar shade trees along city streets. However, only the lower branches were much infested. Good results were obtained from the spray. The poplar tree is one of the varieties most attacked by the Oyster-shell Scale, and we have seen many specimens of this tree killed by this pest. The Lilac bush is often killed by it, and from these experiments it is to be seen that it is not necessary to suffer loss from this source.

The inspection of results was made a month after the spraying and there was consequently time to be certain that the effects were permanent. The best results were obtained by the use of Whale Oil Soap, which can be bought either of local dealers or the manufacturer, James Good, 941 North Front street, Philadelphia. However, the very satisfactory results with brown laundry soap and Kerosene Emulsion show that either of these materials will hold such pests in check and even exterminate them.

There were no living mature or adult Oyster-shell Scales present at the time these applications were made, as explained in another article in this Bulletin, and in this there is a very important difference between treating most of our common scale insects, such as the Oyster-shell Scale and Scurfy Scale, which can be entirely exterminated by one of two thorough applications at the proper time, and spraying for the San José Scale, which, because there are living adults and young on the trees at the same time can not be treated satisfactorily or economically by any means during the summer time.

The habits and dates of appearing of Scurfy Scale are similar to those of Oyster-shell, both having two broods per year in this State, and consequently these remedies can be recommended as well for one as the other. The chief point lies in watching when the young scales hatch and spray them soon afterward.

SUMMER TREATMENT OF SCALE INSECTS.

Many questions are received concerning the possibility of summer remedies for scale insects, and replies to all of these must explain in detail some points that are fundamental in the warfare

with such pests. Among these must be the understanding that there are a great many different kinds of scale insects, and their habits and life histories vary widely. Also, that no scale insects of any kind can be killed in the adult or full grown state with any insecticide that is not at the same time so strong as to destroy the green leaves of plants if it come in contact with them.

All scale insects have a short period of one or two days in which they are young and free-moving and crawl about over the bark of the trees, then fix themselves upon branches, twigs, leaves or fruit. As soon as they are fixed they are anchored forever and are unable to free themselves or move again. While they are young and free-moving and shortly after they are fixed, they are very delicate and easily killed. It is at this particular time that summer remedies must be used if they are to have any effect. These summer remedies consist of contact applications, such as Kerosene Emulsion, about ten per cent., or Kerosene Mixture applied with a Kero-water Sprayer, or Whale Oil Soap, one pound in about six gallons of water, or common laundry soap, or soft soap, one pound in three or four gallons of water. The commercial insecticides, which are mostly crude oils slightly modified, can also be used with more or less varying degrees of success. It is possible to find such strength of any one of the above named contact insecticides as to kill very young scale insects without injuring the foliage or fruit of trees or shrubs. However, it is also possible to get the preparation so dilute or weak that even the young scale insects will not be seriously injured thereby, and as published in our January Bulletin, it is even possible to hasten the secretion or formation of their waxy protecting coat. It is also a very easy matter, if care be not used, to make the insecticide so strong as to injure leaves or fruit.

As soon as any kind of scale insect is fixed it commences to secrete a waxy, waterproof, protecting coat, and as it becomes larger and older this covering, which is the real scale over the soft-bodied insect, protects it very effectively from injury by many contact applications, or from wet or cold. The young insects not only suck the sap from that part of the tree on which they are fixed but inject a poison which varies in degree of severity according to the kind or species in question. It can be seen from the above statement that these pests feed only by sucking sap with their bills, which are inserted into the tissues of the plant, and that poisons such as Paris Green or other arsenites would not injure them in the least because they do not eat the surface of the plants where the poison lies, and this can not penetrate the interior where they feed. At the same time it should not be necessary for us to state that there is positively no known material that can be put into holes in plants that will enter into their sap and become so distasteful or injurious to

insects as to render the treated plants immune from attacks. It is very surprising that here in our own State it is possible for a company to flourish which is engaged in the business of grinding together sulphur, charcoal and resin, at a cost of less than five cents per pound, and selling it at a dollar per pound, to put into holes in trees for scale insects. We have tried it thoroughly and have seen orchards treated by it, and find that at present it remains in the holes in the trees just as it was left last spring, not taken up at all, and has had absolutely no effect in checking the scale or reducing their numbers on the trees which we have recently examined.

It can also be seen from the above remarks that the necessary time of year to apply mild insecticides, which we call summer remedies, is the exact date at which the young are crawling or very shortly after they become fixed. There is an important point in this because this date varies greatly with the kind of scale insect to be treated. The San José Scale (Plates X and XI), which bears living young, is to be found in the young and free-moving stage at all times, day and night, from about the fifth of June to the early part of September. These do not appear in definitely separated broods or generations but each consecutive day the parent bears a few young ones, and consequently during the summer at any and all times it is possible to find specimens of San José Scale representing this insect in all possible stages of its development. This is why if we wish to suppress this particular pest it is necessary to spray at intervals of only a few days each for at least an entire month in order to kill all the young as they appear and also exhaust the reproductive capacity of the parent. Of course, for this insect summer applications are only checks to its increase, and the best and cheapest possible remedy is a thorough spraying with the boiled Lime-sulphur Wash in the spring just before the buds burst.

With the Scurfy Scale (Plate XIII), and the Oyster-shell Scale (Plate XIII), and others such as shown in Plate XII, there are eggs produced beneath the scales. These hatch practically at one time, or in broods which are generally two per year, one in May and the other in the latter part of July or August, while the young of the Lecanium appear later in the fall. The exact date of their appearance will vary with climate, latitude and elevation, and it is very necessary that persons who wish to treat these pests watch for the dates of the young hatching and apply the remedies at such time as they will be effective.

If persons owning infested trees or shrubs are not able to tell by their own examination when the eggs of these insects hatch, or when the young of any species are moving and ready to kill they can apply to this office for aid, and receive the same by sending

us specimens of infested twigs for inspection. The application of remedies mild enough to be safe on leaves will do no good whatever for scale insects excepting when these pests are very young.

The kind of remedy also depends upon the kind of scale insect to treat. For example, we have found that the Lime-sulphur Wash when boiled and thoroughly applied is the best and cheapest remedy for the San José Scale and is also effective against the Cottony Maple Scale (Plate XIII a) and the Turtle-shell Scales or Soft Scales (Plate XIII b and c) as well as against the San José if applied when the leaves are off, especially in the early spring shortly before the buds burst. Our experiments have also proven that the Scurfy Scale can be satisfactorily treated at such times, but owing to the fact that the Oyster-shell Scale is in the egg stage during the winter and early spring and these eggs are protected by a shell that is much thicker and heavier and more closely fastened to the bark than the Scurfy Scale, the Oyster-shell is not to be treated successfully with the Lime-sulphur Wash. Even the treatment for the Scurfy Scale when dormant is not always satisfactory, but we have known the most excellent results to be obtained by spraying these two during summer when their broods of young appeared. It must be remembered that after the egg-laying of those species which produce eggs the mature insects themselves die and shrivel up. Thus when the eggs hatch and the young commence to crawl there are no old ones alive that will be left to continue the species on the trees where the young are killed. This is especially an important reason for killing the young Scurfy Scales and Oyster-shell Scales at the right time of year, and is another reason why summer spraying for San José Scale does not prove satisfactory. During all the summer there are mature and protected San José Scale present among the young ones and even though the latter should all be killed at any one time, the old ones are left alive to continue their injuries to the tree.

As pruning is a means of invigorating a tree when it has been so attacked or injured in any way as to injure it, those trees which are seriously infested at any time should be cut back well. We recommend pruning for this purpose at any time of year although it is not advisable to take off many branches that carry healthy foliage.

While it is impossible to spray trees that are in leaf with very strong insecticides without hurting the foliage, it is possible to wash them at any time with very strong insecticides, even stronger than would be used in a spray pump during winter time, applying this with a brush by hand to the trunk and larger branches and in fact wherever the bark can be reached. By keeping it off the young green shoots and the leaves no injury will come and it is an easy and almost certain means of saving a few choice trees. We have

recently painted the stubs of badly infested apple trees with various preparations, such as Crude Petroleum, strong soap solution, and concentrated Lime-sulphur Wash and have seen good results from these applications. The scales of bark on larger limbs and trunks cover a great many living specimens of San José Scale and should be scraped off before painting them with brushes.

CORRESPONDENCE.

Much of the correspondence of this office is of such a public nature as to justify our publishing some of the injuiries that we receive and their answers for the sake of the many other persons who either do or would ask the same questions. At the same time the publication of these letters relieves correspondence upon similar subjects, because many of the questions that are asked by the scores daily are answered in some of the letters published in the following pages. It will be interesting to know that these are bonafide copies of actual correspondence taken from our letter files and copy books and selected on account of the present general interest in various subjects, while they also show the wide range of topics on which persons write for information.

We are pleased at all times to hear from our citizens along the lines of the work pertaining to this office and give them all help possible. In writing to this office for information it is not only important to send us specimens whenever possible, but also state whether or not the correspondent is receiving our Bulletins. We have back numbers of these pertaining to the various subjects in entomology and zoology, which will be sent free to those who need them.

H. A. SURFACE, Economic Zoologist.

ABOUT ANTS.

Glen Cove, N. Y.

Prof. H. A. Surface, Harrisburg, Pa.:

Dear Sir: Can you tell me how a colony of Carpenter Ants, which has been excavating in the main beam supporting my piazza roof, can be exterminated? They have been at work since last summer,

and it will be a troublesome and expensive operation to have this beam taken out. I have tried injecting into their holes a strong solution of Carbolic Acid—also ammonia as well as sweet oil—but it has no effect, and they are at work again in half an hour. If you know of any means by which these Ants can be destroyed, I will be very much indebted to you if you will let me know.

I have been reading with much interest the information concerning the San José Scale in the Monthly Bulletins you so kindly send me. This scale made its appearance on my place about four years ago. I did not know what it was, but quickly noticing its effect upon my pears, apples and plums, I had during the following winter a scaffolding built around each tree, and had them washed with a cloth and crude petroleum to the tips of the branches. The scale insects were entirely destroyed and none have appeared on the trees since. These trees were all young, none over twenty feet high. I mention this because it is easy and simple for small trees and in many cases has proved completely successful.

Very truly yours,

J. R.

Mr. J. R., Glen Cove, N. Y.:

Dear Sir: Replying to your letter of recent date asking for information concerning the method of exterminating Carpenter Ants in the beam supporting your roof, I beg to say that the most reliable substance for killing these pests is Carbon Bisulphide or Bisulphide of Carbon. You can buy this from Edw. R. Taylor, Penn Yan, N. Y., for ten cents (10 cents) per pound, or at drug stores it should be sold for not more than twice this. A pound will no doubt be sufficient to meet your needs. This is a colorless, heavy liquid, which evaporates or volatilizes easily, and the fumes are heavier than air, explosive and malodorous and very poisonous. Fire should, of course, be kept away from it as away from Benzine or Gasolene. Inject the substance into their holes and stop them up with clay or putty if the holes be small, and with wet paper wads if they be large. Be sure that all openings are closed, even if this must be done by tacking wet newspapers over cracks. Let it remain a few hours. Within half an hour from the time of injection, all the Ants and their pupæ and eggs will be dead. I tried this successfully in killing Ants in lawns and gardens and also in my double walled bee hives, where they were between the walls of the hive. Of course, I removed the Bees first, but soon stopped the Ants from carrying out the sawdust filling. A more easily obtained substance which I think will give you satisfactory results, is Benzine or Gasolene. Inject one of these abundantly into the holes and plug them up or stop them as directed above. I am not so certain that these will give good results, but I would suggest that you try Benzine or Gasolene first as an experiment and let me know the outcome. If they do not give you satisfactory results, you may then rely upon the Carbon Bisulphide.

I am pleased to have your report of the extermination of the San José Scale by washing the trees, to tips of branches during the winter

time with Crude Petroleum. For some time I have been well convinced that this would do the work if thoroughly applied as you say. Of course, it is troublesome and slow, but I really believe any thorough person can exterminate it on his trees by such processes, and I am consequently glad to have your report of this.

Very truly yours,
H. A. SURFACE, Economic Zoologist.

Athol, Pa.

Prof. H. A. Surface, Harrisburg, Penna.:

Dear Sir: Last year the ants destroyed three-fourths of my corn crop and they are very bad this year.

I find the quite small red ant common in our pantries and a larger brown ant attacks the grain about the time the stalk is coming up, also a small black ant somewhat larger than the brown ant that feeds on the stalk, and after the soft grain is consumed all three attack the stalk, which curls and shrivels and soon dies.

I soaked the planting corn in Tarola (coal tar product) but this does no good, and thought possibly that I could poison them by using corn meal, puverized sugar and arsenic. I tried heavy applications of lime and that did no good. The farmers through this section are very much annoyed by these pests and the matter is considered quite serious by our farmers. Any information will be appreciated.

Very truly yours,
J. E. B.

Mr. J. E. B., Athol, Pa.:

Dear Sir: Replying to yours of recent date asking about ants in your corn I beg to say that as a rule ants are present in fields because there are plant lice on the roots and they are feeding on the sweet juices which come from these insects. Prof. Forbes, Urbana, Ill., has written a great deal on this subject, and if you will write to the Experiment Station at that place, asking for the publications upon it, you will receive them, and they will give you more information than I can put into a brief letter.

For the ants in your pantry the best thing to do is to trace their path, as you know they form a string from the pantry to their nest, and pour in an abundance of Kerosene, Gasolene or Carbon Bisulphide, to kill them, and you will destroy the entire nest.

The farm should be cultivated frequently and where there are likely to be ants it should be plowed in the fall and again in the early spring before planting. It is not necessary to poison them in the field as they do not eat poison unless it be syrup or molasses or something of that kind which will carry poison. However, the real trouble is plant lice, which are very small and live on the roots of corn. I have published on ants in my Bulletins several times,

and if you do not have these Bulletins, they will be sent to you. You will find by the index in each annual volume, issued in April, just where the subject of Ants has been treated during the year. If you do not have them, please write to us for them, and we shall be glad to place your name upon the mailing list.

H. A. S.

ANTS AND BEES.

Albion, Pa.

Prof. H. A. Surface, Harrisburg, Pa.:

Dear Sir: I write to you for a little information on preventing Ants from troubling Bees, as I have had more or less trouble with the Small Black Ants. I write to you, hoping there is some remedy. Will you kindly let me know what is best? Bisulphide of Carbon will kill Ants and Bees, so I dare not use this around the Apiary. What I wish to kill is Ants and not affect the Bees.

Hoping you will be able to give me a remedy, I am,

Very truly yours,

T. H.

Mr. T. H., Albion, Pa.:

Dear Sir: Replying to your letter of recent date, asking for the methods of preventing Ants from troubling Bees, I beg to say that if you had given me more detailed information as to where the Ants live and how they are causing the trouble I could answer you with better satisfaction. If, for example, you have double walled or chaff hives, and the Ants are between the two walls or live in the chaff, the best treatment is to remove the Bees and fumigate the hives in which the Ants' nests are found. I did this very successfully just a year ago by merely pouring a half teacupful of Carbon Bisulphide into the space between the walls of each hive and covering it over entirely with oil cloth and letting it remain for an hour. Every Ant was killed and there was no further trouble. However, if the Ants live in the ground or elsewhere around the hives, it is not advisable to try to exterminate them by merely killing those which have come to the hive, as the best possible means is to follow their path until you find their nest and then pour in common Kerosene or Coal Oil, or Benzine or Gasolene in abundance until they are soaked with it, and they will be killed. Kill the queen Ant and the colony is destroyed. If they be in the interior where Carbon Bisulphide can be used by making it practically airtight or gas tight, you can kill them by this, but, of course, you must remove the Bees first. If your Bees be not in hives with movable frames you can not, of course, move them out without the regular process of transferring. You can keep Ants from the hives by placing the hives on very low stands and setting each foot of the stand in a dish or pan of oil. If you will give me greater details about

where these Ants live and how they act, I may be able to help you further. I enclose herewith a circular of the Pennsylvania State Bee-Keepers' Association, and I am sending you a recent Bulletin of the State Association. This Association will be glad to give you all help possible and at the same time have your co-operation.

Hoping to hear from you further, I am,

Very truly yours,

H. A. S., Economic Zoologist.

STALK BORERS.

Hubbard, Ohio.

Editor of N. S., Pittsburg, Pa.:

Dear Sir: While hoeing in the garden I noticed many tomato plants which were wilting, and upon examination found that they had all been stung by some insect and the stem was bored by a worm.

I enclose with this letter a stem and a worm, the name of which I hope you may be able to send me, also mode of dealing with it, that we may lose no more plants by it.

I hope you will find it convenient to answer soon as I desire to know about this worm.

Yours very truly,

A. E. R.

Mr. A. E. R., Hubbard, O.:

Dear Sir: The infested tomato plant was received and examined and the leaves were found to be injured with a shot hole blight or Fungus and the stem bored by some insect, which was not found because it had left the portion of the plant which was sent us and was probably farther down in the stalk. However, this insect was no doubt the common stalk borer, known to Entomologists by the scientific name of *Papaipema nitela.* This insect is known to be very destructive to Tomatoes, Potatoes and a number of other plants besides many large weeds, and we have just received a report of it also injuring corn by boring in the stalk in the same way. It is very difficult to combat, and the best thing possible is to pull or mow all weeds around the premises, so that it will not be able to multiply within the stems of these, and then whenever it injures cultivated plants of any kind, so that the plants commence to whither, gather and burn them. This will at once destroy the insect, and its progeny will not be left for future attacks. I regard this insect as being capable of becoming one of the most destructive of all known kinds. We have found it injurious to dahlias, chrysanthemums, and other flowering plants besides vegetables and truck crops, and it should be destroyed as soon as the plants are found withering from its attacks.

Yours very truly,

H. A. S., Economic Zoologist.

FALL WEBWORMS.

Damascus, Pa.

Pennsylvania State Board of Agriculture, Zoological Department, Harrisburg, Pa.:

Dear Sirs: I am sending you under separate cover, a leaf from cherry tree, covered with caterpillars. Kindly advise what they are and method to use to get rid of them.

Very truly,

B. L. T.

Mr. B. L. T., Damascus, Pa.:

Dear Sir: I have received the insects on the leaf of your cherry tree, 7082, and find them to be Fall Webworms. This insect is wrongly called the Tent-caterpillar by many persons, but it is entirely a different thing. It spins a loose web over the leaves on which it feeds, thus being mostly on the outer parts of the branches. The Tent-caterpillars come early in the summer and feed mostly upon the trees belonging to the Rose Family, such as Wild Cherry, Peach, Apple, Pear, etc., and make large tents at the forks of the branches of the trees and live in these. The Fall Webworms, which are the specimens sent, live within their webs practically all the time and extend this thin gauze-like webbing over the new leaves in order to reach their food. These pests feed on a great variety of trees, and are liable to be quite injurious to forest trees as well as certain cultivated trees, but as they come in the latter part of the growing season after the leaves are practically mature their injuries are not so great, as are those done by the Tent-caterpillars in stripping the trees of the same amount of foliage earlier in the season.

The remedy for practically all leaf-eating insects is to spray with an arsenical poison, such as Paris Green, one pound in about one hundred and fifty gallons of water, or Arsenate of Lead, two or three pounds, in fifty gallons of water, or such other poisons as are mentioned in our May Bulletin. The formulæ are there given in detail. This will be sent free to persons who do not have it. In spraying for the Fall Webworm it is necessary to use considerable force for driving the spray through the fine webs in order to reach the larvæ where they are feeding. If this can not be done, spray thoroughly the foliage as near the webs as possible, or cut off and burn the branches containing them or strip them entirely from the trees by hand. It is not advisable to burn insects of any kind on trees by the use of a torch while the pests are on the trees, because you are in danger of inflicting more serious injury to the trees by fire than would be done by the insects themselves. You will find the Fall Webworms and the remedies for the same mentioned in Nos. 5 and 12 of Volume I, and pages 27, 108 and 115, Volume II, and pages 100, 119 and 135 of Volume III of the Monthly Bulletin. I suppose you have preserved files of these, but we can send you some from our duplicates if you do not have them.

Very truly yours,

H. A. S., Economic Zoologist.

TENT CATERPILLARS.

Philadelphia.

H. A. Surface, M. S. C., Esq., Department of Agriculture, Harrisburg, Penna.:

My Dear Sir: Replying to your letter to me under date of June 1st, and thanking you for the same, I write to say that apparently the caterpillars which are in a slight degree attacking both my shade and fruit trees are of the Tent Caterpillar variety. I note the prescription regarding the Paris Green and will follow out the same.

I am writing to ask whether there is anything that you can do to the trunk of a tree from the ground up to the limbs which will prevent the pests from ascending the trees and destroying them? Any information on this line will be appreciated.

Yours very truly,

G. Q. H.

Harrisburg, Pa., June 22, 1906.

Mr. G. Q. H., 604-607 West End Trust Building, Phila., Pa.:

Dear Sir: In answer to yours of the 21st I would say that if it be the Tent Caterpillar that is attacking your trees there is nothing that can be applied to the trunk of the tree which would affect the insect. Where such Caterpillars crawl from the ground to the limbs, a barrier made of an inverted wire screen, or with sticky fly paper, wool, or cotton, or a band of tar will often very effectively prevent them ascending. However, the Tent Caterpillar does not regularly ascend the trunk of the tree to get to the top, but its eggs are laid by the adult moth in rings about small twigs, and these eggs hatch out in the top where they are laid, and hence the insect is ready to commence eating the foliage immediately upon hatching. However, they may drop to the ground and then crawl up. They also commence their work near the nest and work outward, and these nests which they spin always cover the twigs near where the egg masses were originally laid. In case of the Tussock moth it is different. This is the white, black and yellowish Caterpillar with the red tufts at either end of the body, and it is generally found on shade trees in your section of the State. The eggs of this Caterpillar are laid by the wingless female upon the cocoons which are spun about the trunks of the tree, and if these can be pulled off and destroyed it will prevent a new brood from appearing.

Yours very truly,

H. A. SURFACE, Economic Zoologist.

TO KEEP FLIES AWAY.

New Castle, Pa.

Prof. H. A. Surface, Harrisburg, Pa.:

Dear Sir: In the May, 1905, issue of the monthly bulletin of the Division of Zoology on page 21 there is a formula given as fish oil to be used to keep flies off horses and cattle that I would like to have filled. I took it to a druggist, but he said while he had the material, he did not know how much of each to use as the formula reads: Fish-oil, 100 parts; Oil of Tar, 50 parts; Crude Carbolic Acid, one pint. The "parts" is what he does not understand. So I refer to you to help us out. Please tell us how much 100 parts is equal to, in pints, etc. I enclose postage for reply.

Respectfully,

W. C. W.

R. F. D. No. 3, New Castle, Pa.

Mr. W. C. W., New Castle, Pa.:

Dear Sir: Replying to your letter of recent date, asking about the formula for Fish Oil to keep Flies from horses and cattle, I can say that the unit is one pint, and in saying one pint of Crude Carbolic Acid this is the same as saying one part of the same. It would thus be as follows:

Crude Carbolic Acid, one pint or one part.
Oil of Tar, fifty pints or fifty parts.
Fish Oil, one hundred pints or one hundred parts.

For making a less amount use these proportions. Mix well together and use as a light spray over the animals to be protected and it is reported to me that the Flies will stay away for some time. Unfortunately, I have not had opportunity to try this for myself. I should be glad to learn the results of your experiments in this line.

Very truly yours,
H. A. S., Economic Zoologist.

MITES OR RED SPIDERS ON LEAVES.

Philadelphia, Pa.

Dr. H. A. Surface:

Dear Sir: I take the liberty of writing, to ask if you will kindly inform me what is the trouble with a fine young Black Tartarian cherry tree I have, also what is the remedy to use to restore it?

Up to this time it has been very healthy, and this spring made vigorous growth, as in the past. Lately the leaves have turned, as per enclosed sample. The tree had a thorough dose of Lime-sulphur this spring. When your inspector visited my place, he commented on the thorough manner the trees had been treated, so I do not think it comes from lack of attention on this score.

Thanking you for any advice you can give me.

I am truly,

T. H. S.

Mr. T. H. S., Germantown, Philadelphia, Pa.:

Dear Sir: I have received and examined the leaves of Black Tartarian Cherry, 7083, which you sent to me, and find them to be infested with Mites, commonly called Red Spiders or Red Mites. This injury can be checked at once by spraying with Potassium Sulphide or Livers of Sulphur according to formula No. 6 in our May Bulletin, of which I am sending you a copy, and this fall about the time the leaves drop or when they are mostly off spray with the boiled Lime-sulphur Wash and again next spring spray with it, and you should have complete control of them. It is not usual for a tree that has been sprayed with the boiled Lime-sulphur Wash and thoroughly coated to be so infested with Mites as this is. I note that you say this had a dose of the Lime-sulphur Wash in the spring, will you kindly tell me how it was prepared and if it was boiled, and if so, how long?

Hoping to give you further aid when needed, I am,

Very truly yours,

H. A. S., Economic Zoologist.

SOFT SCALE OR MAPLE LECANIUM.

Pittsburg, Pa.

State Forestry Commission, Harrisburg, Pa.:

Gentlemen: We have about one dozen maple trees on the grounds of the Lincoln Avenue School yard that are infested with turtle-back scale. Will you please send us as early as possible material for spraying of same, with directions how to use it?

Yours truly,

G. M. H.

Harrisburg, Pa.

Prof. G. M. H., Pittsburg, Pa.:

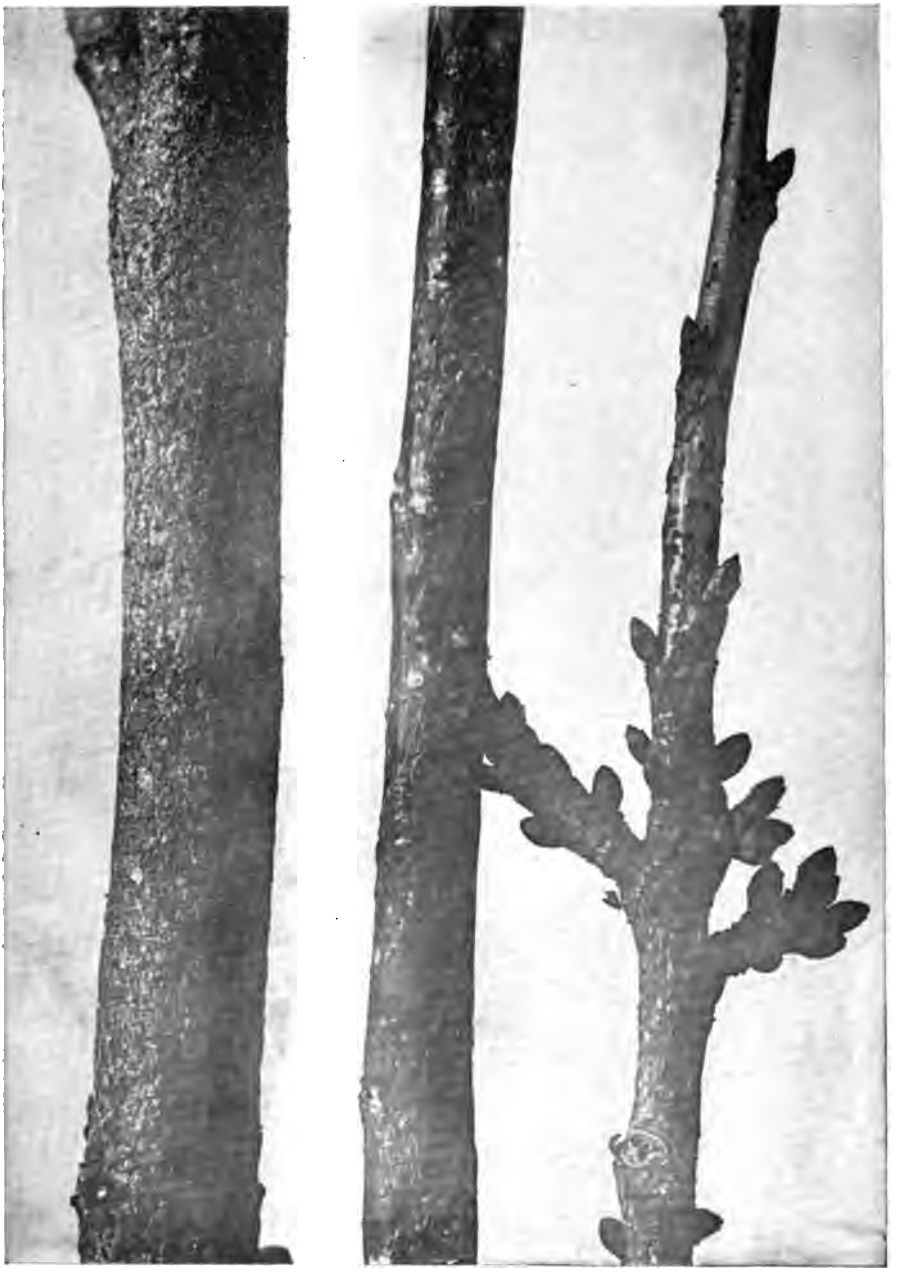
Dear Sir: Your letter to the Commissioner of Forestry asking for material to treat your trees for the Lecanium scale has been referred to us, and in reply we beg to say that this Department does not furnish material for the treatment of trees other than for ex-

Fig. 1.—San José Scale (*Aspidiotus perniciosus*) on branch of Apple, natural size. On piece of bark at left, above, are magnified specimens. (*By Howard, in Circular of Div. of Ent., U. S. Dept. Agr.*)

a *b*

Fig. 2.—a, San José Scale on Pear Twig, natural size; b, San José Scale, greatly enlarged, showing the crawling young and the different ages of the insect in the fixed stage. This shows just what can be seen with a good microscope on badly infested trees during the entire summer, after about the tenth of May. (From *Howard and Marlatt, in Bull. of Div. of Ent. U. S. Dept. of Agr.*)

PLATE X.



a b c

FRUIT TREE BRANCHES WITH SAN JOSE SCALE.

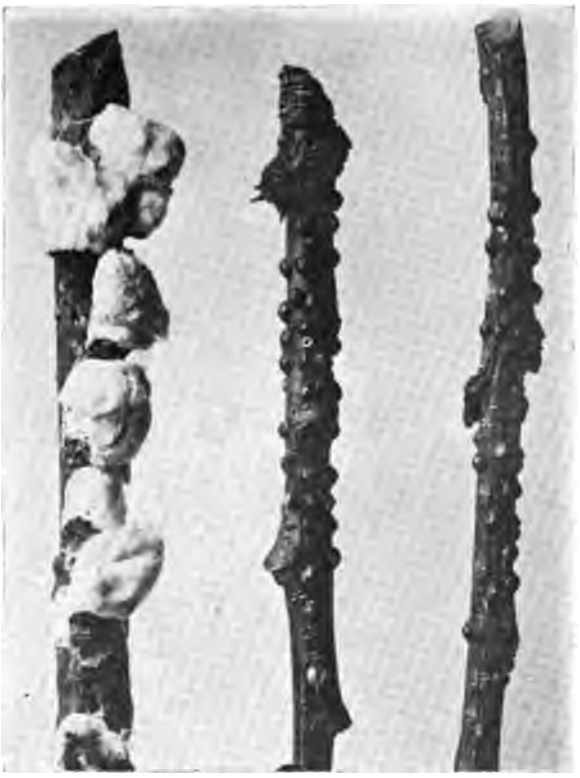
a. Scale in Winter Resting Stage.
b. Full grown or Adult Females.
c. Scale in Winter Stage, on Sweet Cherry.
All Natural Size and Good Illustrations.
Photograph of Specimens in the Office of the Economic Zoologist.

PLATE XI.

a b c

PLATE XII. SCALE INSECTS.

a. Scurfy Scale. Small Specks, Males; Large ones, Females.
b. Scurfy Scale. All Females, Adult.
c. Oyster Shell Scales.
All photographed in the Office of the Economic Zoologist.



a b c

PLATE XIII. COMMON SCALE INSECTS.

a. Cottony Maple Scale.
b. Lecanium or Turtle-Shell (Soft Scale) on Plum.
c. Lecanium or Turtle-Shell Scale on Maple.

perimental purposes. You can readily see that it would be impossible to do that, for practically every tree in the State is infested with some insect or other and the State is not rich enough to pay for the material which would have to be used.

The Lecanium scale is best treated by spraying with either Whale Oil Soap or common laundry soap, 1 pound dissolved in 5 or 6 gallons of water, or Kerosene emulsion not over 10 per cent. Kerosene. This is probably the best time to spray for the Levanium scale, as they are just hatching in your section and are in the least resistant stage. The Kerosene Emulsion is made by preparing a stock solution of 1 gallon of water and 2 gallons of Kerosene in which is stirred one-half pound of soap, which when well stirred forms an emulsion and prevents the Kerosene from separating from the water. This makes a 66 per cent. Kerosene emulsion and it can be diluted to the 10 per cent. solution when it is ready to use. If you do not have a spraying apparatus and the insects are found on the larger limbs and the trunks of the trees it will be well for you to go over them with a large brush, painting them with this same material. All that is necessary is to bring the material into contact with the body of the insect, which will kill it. I do not know if this is satisfactory to you or not, but it is the best we can do and it is no doubt all that is practicall for us to do along this line.

If we can be of further service to you do not hesitate to write us.

Yours very truly,

H. A. SURFACE, Economic Zoologist.

SAN JOSÉ SCALE.

Jersey Shore, Pa.

Prof. H. A. Surface, Harrisburg, Pa.:

Dear Sir: I have a small pear tree that has no fruit on yet. It has the San José Scale, and even some of the leaves have some dark red or brown spots on them, and the scale was nearly over the whole tree before I saw it. What can you advise me to do with the tree. Should I cut the tree down and burn it, or can you tell me how to save it?

Hoping to hear from you at once, I am,

Yours truly,

A. T. S.

Harrisburg, Pa.

Mr. A. T. S., Jersey Shore, Pa.:

Dear Sir: Replying to your letter asking what to do for the San José Scale at this time of the year, I beg to say that you can spray with 10 per cent. Kerosene Emulsion or Whale Oil Soap, 1 pound in 5 or 6 gallons of water. It will require several applications at intervals of about one-half week each to succeed with this. I do not consider it necessary to cut down a tree, but if you will persist

in spraying you can hold the scale in check, so that you can spray thoroughly and entirely control it when the leaves drop this fall. Thoroughly painting all the bark with a thick soap solution, by hand, using a paint brush, will also do the work.

I send you herewith a copy of our June Bulletin of last year and also of the previous year, containing articles upon the subject of summer remedies for scale insects. This gives you full information.

Yours very truly,

H. A. S.

PEAR BLIGHT.

Port Royal, Pa.

Prof. H. A. Surface, Harrisburg, Pa.:

Dear Sir: I have the Blight on Pear trees and would like to know what to do for it. I do not want to loose my trees. It is the Black Blight. Please answer and advise me.

Yours respectfully,

D. H.

Harrisburg, Pa., June 22, 1906.

Mr. D. H., Port Royal, Pa.:

Dear Sir: In answer to your card of the 19th ult. I would say that if you pear trees be afflicted with Pear twig blight the only treatment which will be effective is to cut off the diseased branches a foot or eighteen inches below where the leaves begin to die and burn them. This Blight is of a bacterial nature, and is communicated from diseased twigs and leaves by insects through the growing flower and buds, when they go in search for honey, and by other means. If these twigs, which show the dead leaves hanging tightly to them, be cut off some distance below the union of the dead and living wood, and these be kept cut off through several seasons and burned, it is possible to check its spread. The pruning knife should be sterilized occasionally by dipping into turpentine. This Blight is particularly prevalent in a wet season or where the soil about the trees has been well cultivated and well fertilized. Such cultivation and fertilization induce very quick growth, which of course is tender, and it is much easier for the bacteria to find a lodging place than in the slower growing trees. For this reason it is best where there is danger from blight not to hurry the growth of the trees, but rather induce a slow growth, which will insure harder wood, and the Blight will not be so likely to affect it. There is no spraying or any other treatment which will be effective as a remedy or preventive. Burn all infected twigs and brush as soon as the disease is noticed.

Yours very truly,

H. A. SURFACE, Economic Zoologist.

CARE OF TREES.

Pittsburg, Pa.

Gentlemen: As I have a Plum Orchard of 1,200 trees five years old, I would be pleased to get some information concerning care of same. I understand your Department gives out such information. I have been working the orchard with disk harrow and the trees are making good growth except about one dozen in one corner of orchard that don't seem to grow, but have a yellowish cast. I have thought these possibly were affected with San José Scale. Will you kindly let me know. What is the best way to treat these trees that are affected. These Plums are of different varieties but the ones affected are Japan. I have not had a crop of plums yet. The Japans would have been full of bloom but the March freeze killed them. The other varieties consisting of about 1,000, have not shown any inclination to bloom. I have worked the orchard with disc harrow every three weeks during this summer. Do you consider this should be kept up every year working the soil to the tree? I would also be pleased to know of the latest and most improved way to spray or dust the trees in spring, also the name and address of the most up-to-date fruit journal if there is one published. Thanking you for any courtesy you may extend. I am,

Very truly yours,

R. B. H.

Mr. R. B. H., Pittsburg, Pa.:

Dear Sir: Replying to your letter of recent date in which you say that some of your plum trees have a yellowish appearance, and you think they may possibly be infested with San José Scale, and asking treatment for the same, I beg to say that it is not necessary nor even advisable to go to the trouble and expense of treating trees for San José Scale if this pest be not present. Therefore, the first step to take is to learn whether the pest be present, and to learn this kindly send us a few twigs by mail, and we shall examine them under a microscope and let you know exactly what we find. If there be any San José Scale present it will be revealed by this method. If it be on your trees to any injurious extent, it will be almost certain to be present upon some of the twigs sent. You can send samples from different trees by numbering your trees and numbering the twigs accordingly, so that we can give you a reply according to what we find on each. If our examination should prove that the scale is present, we shall send you special literature upon this subject, yet I can assure you that there is nothing more reliable nor certain to give relief than the boiled Lime-sulphur Wash and kindred remedies discussed in full in our February Bulletin of which I am sending you a copy.

Concerning the cultivation of your plum orchard, I can say that it appears that you are giving the proper treatment, and we observe that the best and most successful fruit growers keep up the cultivation of their plum orchards, not for the sake of any crop to be grown between the trees, but for the benefit of their trees.

Replying to your questions concerning the latest and best way of spraying or dusting trees, I can say that the dust spray has not yet proven entirely satisfactory, and I am convinced that you will have better results in spraying any trees as small as plum trees, which you can easily reach, by a barrel sprayer with liquid spray. Use the Bordeaux Mixture about the time the buds burst, then spray with the Bordeaux Mixture and Paris Green just after the flowers fall (but not while in bloom) and again every ten days or two weeks spray with Bordeaux Mixture and Paris Green, according to the formula given in the May Bulletin, until the plums are half grown, when you need not use the Paris Green, but use the Bordeaux Mixture until the plums are nearly full grown or two or three weeks before they commence to ripen. If there should be any danger of staining the fruit with a permanent stain at the time of the last spraying, use the Cupram formula which does not make a stain, or Soda Bordeaux.

To prevent Rot spray as the fruit commences to ripen with the Cupram formula, which is also given in the May Bulletin. No other spray will be needed unless you have the San José Scale, when the trees should be sprayed both fall and spring with the boiled Lime-sulphur Wash until you get control of it. After that, one spraying given each tree, double-coating all, in other words going over it twice within a few days, in the spring just before the buds burst will be all that you need to give you complete control of this pest and result in good crops in spite of the presence of Scale and the fact that many remain unkilled. You will find that this will have a good effect in preventing the Plum Rot and Peach Rot and many fungus diseases of fruit and leaf and twig, and also in destroying the eggs of certain insects like the Tent-caterpillar, Canker Worms and other pests found on the twigs. I am well convinced that whether you have the San José Scale or not, if you will spray a few of your trees with the Lime-Sulphur Wash, coating them thoroughly by a retouching or second spraying, next spring just before the buds burst, you will then see such beneficial results during the summer and fall that you will henceforth spray with this material whether there be scale or not.

Replying to your inquiry about a good fruit journal, I can refer you to three: "The American Fruit Grower," published at St. Joseph, Missouri; "Green's Fruit Grower," published at Rochester, N. Y., and "The American Fruit Culturist," published at Rochester, N. Y.

Please write us for any further help we can give you.

Very truly yours,

H. A. S.

BORDEAUX MIXTURE ON FRUIT.

Bendersville, Pa.

Prof. H. A. Surface, Harrisburg, Pa.:

My Dear Sir: Is there any danger from poison to spray my peaches in the next few days with Bordeaux? I sprayed the one side about ten days ago, and would like to spray the other side. An early reply will be appreciated.

Yours truly,

J. H. P.

Harrisburg, Pa.

Mr. J. H. P., Bendersville, Pa.:

Dear Sir: There will be no danger whatever in spraying peaches with the Bordeaux mixture at this time or any other time. There will not be enough poison from the Bordeaux get on the fruit to injure persons by eating it. Peaches and all other fruits could be sprayed with this material when ripe and eaten immediately without any ill effects on those who consume them.

Yours very truly,

H. A. SURFACE, Economic Zoologist.

SPRAYING FOR PLANT DISEASES.

Bowmansville, Pa.

Prof. H. A. Surface, M. S., Economic Zoologist, Harrisburg, Pa.:

Dear Sir: I have about 1,000 hills of Lima Beans, and in the beginning of last week I noticed that mildew appeared on some of the pods. I at once referred to your Monthly Bulletins for a remedy, and find that you say Spray with Potassium Sulphide before it appears. Will this be any benefit after it has commenced? In Vol. 3, No. 1, I find on page 11, Formula 11, Potassium Sulfid. Is this the same as Potassium Sulphide? If so where can I get the Potash required? I asked at one of the Reading drug stores for it and they said I should go to one of the hardware stores to get it, but the article I can get there is not the pure Potash. If I cannot stop the mildew on the Lima beans we will not get any, as it goes over the whole patch in a short time if it keeps on as it did the last few days.

Yours truly,

F. S. S.

Mr. F. S. S., Bowmansville, Pa.:

Dear Sir: Replying to yours of recent date, asking about the application of a fungicide for Mildew on the pods of lima beans after

the evidences of the disease have appeared, I beg to say that this question involves a point concerning which I have much correspondence, and I therefore take this opportunity to reply to you with some detail, with the expectation of publishing my reply so that it can be sent to other inquirers and save much correspondence along this line.

For all plant diseases a preventive rather than a remedy is necessary. After the tissue of the plant has really become diseased there is no way of reaching the disease germs, because they are in the interior of the plant and materials sprayed on the outside would not get to them. The advertisements of substances to inject into plants to be taken up by the sap to act as medicines, are entire nonsense and bogus. A safe fungicide is, of course, the Bordeaux Mixture, made according to the formula given in the May Bulletin which I note you have. If there be objection to the slight coloring of the Lime, this can be made with sal soda instead of Lime. It will then be clear and leave no stain. For Mildew, however, a sulphur compound is best to use, as the Bordeaux Mixture is not as effective as some such material as Potassium Sulfid or Sulphide, which are the same, also known as "Livers of Sulphur." This should be sold at about twenty-five cents per pound at the drug stores, and is a very valuable preventive of Mildew on any kind of plant, such as Beans, Peas, Roses or wherever it may be liable to occur.

If one be not able to buy Livers of Sulphur he can make it by mixing together in a barrel or other vessel thirty-two pounds of Potash (also known as Caustic Potash), thirty-seven pounds of fine Sulphur (Flowers of Sulphur), and two pounds of Salt, in about forty-five gallons of water. The full amount of water need not be used at first. This will make a barrel of stock solution and when you are ready to spray it on the leaves of the plants take one part of this, after stirring it up well, to one hundred parts of water. It is one of the best remedies against Mites or Red Spiders, as well as preventives of Mildew upon any plant. The Potash or Caustic Potash does not need to be chemically pure, and can be purchased of any good general druggist or wholesale drug firm. If you can not otherwise obtain the names and addresses of firms that will supply you with this maternal, write to me for them, and I can give them to you.

I now come to the important question as to whether a fungicide should be applied after the evidences of a disease appear. In reply to this I can say that nothing will cure those parts of the plant that are already diseased at the time of application, but if the disease has just started in the plant, it is often possible to spray with a fungicide and prevent its spread to other leaves of the same plant, and certainly to other plants. Thus it is advisable to spray plants that are slightly infected with a disease whether it be Blight (as of Potato), or Mildew or Rust, but one will not have as good success in checking it as though he had sprayed early enough to prevent its appearance. I recommend spraying as long as there is enough healthy tissue in the plant to justify trying to save it or keep it so, but it must be remembered that spraying will not re-

store the health or vigor of the parts that are already diseased at the time.

Hoping this gives you the help you need, I am,

Very truly yours,

H. A. S., Economic Zoologist.

HOUSEHOLD FUMIGATION.

Millville, Pa.

Prof. H. A. Surface, Harrisburg, Pa.:

Dear Sir: In your Bulletin, issued April 1, 1906, you published a formula for ridding a house of fleas. We are now living in an old house infested with bugs. Does the fumigation injure the brass or varnish on furniture, and if bedrooms are fumigated in the early morning for three hours and then aired the remainder of the day, is that all the cleaning necessary? Would beds be safe to sleep in without a change of linen? If a kitchen were fumigated for flies, would cooking utensils need cleaning before using? Are the chemicals expensive? If the time will permit please answer my questions, for which I will feel very grateful.

Respectfully yours,

Mrs. ——— ———.

Mrs. ——— ———, Millville, Columbia county, Pa.:

Dear Madam: Replying to your recent letter, asking for further information concerning the fumigation of a house for insect pests, I beg to reply as follows:

(1) The fumigation does not injure metal, varnish, clothing nor food substances. I have used it in my house very recently and with decided temporary success for House Flies, and also used it a year ago for Clothes Moths, and saw no objectionable effects on any article in the house.

(2) After the rooms have been aired for an hour or more they will be ready for occupancy.

(3) The beds are safe to sleep in without changing them, although I would recommend opening them for an airing.

(4) It is not necessary to give special attention to cleansing or washing cooking utensils after a kitchen has been fumigated for House Flies. They are not injured in the least as far as the effect upon the healthfulness of mankind by eating food from them.

(5) The cost of the chemicals will be from twenty-five to forty cents per pound for the Cyanide of Potassium, and the Sulphuric Acid costs about two and one-half cents per pound. For fumigating a room of the average size, according to the formula which we recommend, the cost would be only from fifteen to twenty cents for the material alone. I am giving you the prices of a Philadelphia chemist without freight rates or express charges added. These

are prices for pure chemicals put up in small packages. When buying larger quantities the prices are less. Of course, the local druggist is justified in charging a little more.

In fumigating for household pests of any and all kinds I have found one ounce of Cyanide of Potassium for each two hundred cubic feet of space to be sufficient, although there is no objection to using it according to the stronger formula of one ounce of Cyanide for each one hundred cubic feet of space.

To determine the amount to use in any room multiply the length, breadth and height, and thus learn the number of cubic feet, and divide this by two hundred, which will give you the number of ounces of Cyanide of Potassium to use. The formula for making the gas is as follows: Cyanide of Potassium (98 per cent. pure), one ounce; Sulphuric Acid (specific gravity 1.83), two ounces; water, four ounces. The water and Sulphuric Acid are to be measured by liquid measure, counting sixteen fluid ounces to a pound, while the Cyanide comes in hard white lumps and is to be weighed. I use Avoirdupois Weights, or sixteen ounces to the pound.

In using this material remember that the gas is very deadly to a person and to breathe it into the lungs twice will cause instant insensibility and death. It is perfectly safe to use, however, if done with proper care. The room to be fumigated should be closed tightly, excepting the door. Strips of wet paper should be patted with the hand over all window cracks to keep the gas from escaping and air from entering. If it be impossible to close the room tightly, as for example, with a barn or corn crib, it is likewise impossible to fumigate it successfully and kill the pests. Remove from the house all living plants and pets.

In the middle of each room place several thicknesses of newspaper under a stone jar, crock, washbowl or pitcher (never metal), holding two or three times as much as the material that will be needed in that room. Compute the amount of each kind of material needed for each room, measure the proper amount of water and pour it into the vessel, then pour in the needed amount (half as much) of Sulphuric Acid. After weighing the necessary amount of Cyanide of Potassium, put it into a paper sack at one side of the vessel. Prepare thus all the rooms that are to be fumigated, leaving the Cyanide in the paper sack at the side of the vessel until all the rooms are ready for the operation. Then begin at the farthest or top-most room, dropping the bag containing the Cyanide into the vessel with the Acid and water, and leave the room immediately, closing the door tightly; going to another room, drop the bag of Cyanide into the dilute Acid, as in the former room, close the door tightly, and pass from the upper rooms to the lower rooms, fumigating above first, because if one should first fumigate the lower rooms he could not escape without returning to go out through the rooms containing the poisonous gas. This gas rises, as it is lighter than air, and for that reason it is not advisable to fumigate the lower rooms while living in the upper rooms unless the floor be tight and free from cracks, and windows in the living rooms all be open and a good current of air be moving through.

I have successfully fumigated upstair rooms while living downstairs by opening and airing the rooms which we occupied during the process. However, we would not consider it entirely safe

to fumigate lower rooms while living in the upper rooms, because the gas rises. If one must fumigate one room while living in another adjoining it, let him have the former room tightly closed and the cracks between them closed with wet paper or wet cloth and keep it air-tight. and have the windows of the living room open and the air blowing through. However, it is certainly safest and best to vacate the entire house during the hour of fumigation. Let the rooms of the entire building remain closed for an hour or more and then open the windows and doors for an airing. This should be done with care. It may be possible in many cases to raise the windows from the outside by the use of poles to push up the lower sash, or by providing before the fumigation to pull down the upper sash with ropes tied to nails driven in the sash for the purpose of lowering them. Although windows can be opened from the inside, it is a greater means of insuring safety to be able to open them from the outside. In my experimental work I have many times held my breath and walked boldly into a room with the poisonous gas, thrown open the windows, walked out again into the pure air before breathing, and found no ill effect whatever. If the fumigation be done in the morning, the gas will practically disappear before evening, and there will be almost no danger whatever in entering any room in the house for the purpose of opening it for ventilation. The gas smells very much like the odor of burning peach kernels or reminds one of the flavor of peach kernels, as it is the well known Prussic Acid. When the operator preceives this odor he should lose no time in getting away from it.

With this information and that which I have already been publishing in my Bulletins from time to time no person need suffer from Flies, Mosquitoes, Bedbugs, Clothes Moths, Mice, Carpet Beetles or Moths or other pests in the household or pests in granaries or tight wheat bins, or in mills, or other buildings or structures that can be tightly closed.

If information be needed concerning the names and addresses of firms of which to buy these or other materials, write to us directly.

Very truly yours,

H. A. S., Economic Zoologist.

GRAIN WEEVIL.

Penfield, Pa.

Mr. H. A. Surface, Harrisburg, Pa.:

Dear Sir: I mail you under separate cover 12 specimens of a little bug that is infesting the stores and wholesale houses in this section. They mostly live in cereals, rolled oats, flour, feed and most any kind of grains. Do you know anything about them, and what can be done to get rid of them?

Very truly yours,

J. H. C.

Mr. J. H. C., Penfield, Pa.:

Dear Sir: The insect you sent to us injuring stored grain, etc., is the Silvanus Beetle or Grain Weevil, scientific name *Silvanus surinamensis*. It is to be killed by fumigating with Carbon Bisulphide or Hydrocyanic Acid gas. For my part, I prefer the latter. I have killed them in mills with this, and can assure you that there is no injury whatever to foods or grain products from the gas, although this is very poisonous to mankind and all forms of animals and insects and even growing plants. I have published upon this in my Bulletins and send you copies of the same. If after reading the articles upon fumigation you wish further information, please let me know.

Yours very truly,
H. A. Surface, Economic Zoologist.

LADY BEETLE.

Millerstown, Pa.

Prof. H. A. Surface, Harrisburg, Pa.:

Dear Sir: The enclosed was on a Sweet Apple Tree. Kindly give me some information concerning it, and oblige.

Yours truly,
A. J. H.

Mr. A. J. H., Millerstown, Pa.:

Dear Sir: Replying to your communication concerning the specimens you sent to us on July 20, which we have received and entered as 7002, I beg to say that these are the pupa shells of Lady Beetles. The Lady Beetle or Lady Bird is a very beneficial insect which feeds on plant lice, the eggs and young potato bugs and other softbodied insects. When it is young it is somewhat like a grub and crawls about on the leaves hunting for insects on which it lives. Then it shortens up and becomes a chrysalis and rests a while, when it bursts and out comes the Turtle-shaped Lady Beetle. Since this is found on your sweet apple tree, it is my opinion that it was feeding on plant lice or green aphids that attacked your trees earlier in the season. It is, therefore, beneficial, and it would be well for you to learn to recognize it in each of its stages and preserve it whenever possible.

H. A. S.

INDEFINITE REQUEST.

Sinking Spring, Pa.

Hr. H. A. Surface, Harrisburg, Pa.:

Dear Sir: Can your Department give me any information as to the method of taking care of cherry trees in a backward condition. Any

Bulletins or publications of general help to the farmer will be appreciated.

Yours truly,

W. S. D.

Mr. W. S. D., Sinking Spring, Pa.:

Dear Sir: In answer to your card we would say that we can not give you any definite recommendation for treating your cherry trees because of the fact that there are several dozen plant diseases and insect pests which may be attacking them, each of which will require treatment different from the others. If you know of any pest infesting your trees it would be best to send us samples of them or of leaves and twigs of the trees and upon examination we can then tell you better what to do, or if you will send us portions of the dead twigs, we might also be able to tell you what caused the injury. We are sending you several Bulletins and are placing your name on our regular mailing list for these Bulletins in the future. You may find some articles on fruit growing that may be useful to you from time to time.

Yours very truly,

H. A. S.

OUR MONTHLY CHAT WITH READERS.

The Delayed Bulletins.—Owing to a necessary wait for plates to be made the June Bulletin was very late and the July number is likewise delayed. This unavoidable delay has been the cause of several persons writing us asking why they have not received their Bulletins for June and July, and especially insisting that they do not desire their names to be dropped from the mailing list. Such unnecessary questions have added to the duties of this office by the greatly increased correspondence, and have aided in preventing much work that should have gone toward the necessary correspondence. We wish to state that no one's name has been dropped from the mailing list without at least three notifications, and no other names will be dropped under any circumstances this year. There is room to add several others which may be sent to us with addresses at any time.

Reptiles Needed: To advance our studies of the Reptiles and Amphibians of Pennsylvania we need many more specimens of all kinds of Snakes, Turtles, Lizards, Salamanders and Frogs. Our Preliminary Reptile Report will be sent to each person sending us one or more of these, but can not be issued until we have more specimens. Please help us by sending them(dead) in a box of damp grass, by express, at our expense, to H. A. Surface, Economic Zoologist, Harrisburg, Pa.

SPECIMENS RECEIVED DURING MAY.

The following list is an acknowledgment of those specimens received by us during May, sent by voluntary contributors, and does not include those which have been collected by our direct representatives or persons from this office. We regard the names appearing below as our "Honor List" for the month, and wish to express publicly our sincere thanks for the help they have in this way rendered this office and their fellow citizens.

Number.	Specimen—Insects.	Date—May, 1906.	Name and Address.
5717	Oyster-shell Scale,	1	D. W. Will, Glade.
5718	Oyster-shell Scale,	1	C. A. Ganatt, Lake Como.
5720	(a) Cecropia Cocoon, (b) Polyphemus Cocoon, (c) Moth chrysalis, (d) Oyster-shell Scale,	1	P. A. Apple, Middleburg.
5721	Promethea Cocoons,	1	Mrs. E. Morton, Ingram.
5722	Work of Shot-hole Borer,	1	H. B. Diener, Jonestown.
5723	Insects,	1	C. Anderson, Harrisburg.
5727	(d) Beetles,	1	H. A. Brightbill, Jr., Marsh Run.
5730	San José Scale,	1	E. Ramsden, Fort Washington.
5733	Oyster-shell Scale,	2	G. Van Etten, Lenoxville.
5734	(a) Oyster-shell Scale, (b) Scurfy Scale,	2	J. D. White, Olivia.
5735	Oyster-shell Scale,	2	Miss M. S. Paxson, Carversville.
5736	Oyster-shell Scale,	2	A. Kitchen, Benton.
5737	Lecanium,	2	E. S. Breidenbaugh, Gettysburg.
5739	San José Scale,	2	G. B. Orlady, Huntingdon.
5740	Female Canker Worm and Eggs,	2	C. Shaffer, Hooversville.
5741	Oyster-shell Scale,	2	M. Horton, Towanda.
5742	(a) Chrysalis of Gordius sphinx, (b) Chrysalis of Grape Leopard Moth,	2	L. H. Goodenough, Girdland.
5744	(a) San José Scale, (b) Coleoptera Eggs,	2	B. S. Merrel, Wilkes-Barre.
5745	Beetles (Serica iricolor),	2	W. Stewart, Landisburg.
5749	Greenhouse Scale (C. ficus),	2	E. C. Tyson, Flora Dale.
5753	Oyster-shell Scale,	3	A. L. Miller, Edella.
5754	(a) Oyster-shell Scale, (b) Scurfy Scale,	3	M. G. Johnson, Grassflat.
5756	San José Scale and Katydid Eggs,	3	F. Glass, Churchtown.
5757	San José Scale,	3	J. Rife, West Fairview.
5759	(a) Scurfy Scale, (b) Plant Lice,	3	J. H. Sherman, Montoursville.
5761	San José Scale,	3	W. J. Smith, Schuyler.
5764	Oyster-shell Scale,	4	E. B. Spencer, Grampian.
5765	Great Leopard Moth Larva,	4	Glass Bros., Salina.
5768	San José Scale,	4	A. L. Kulp, Perkasie.
5774	Gall Making Plant Lice,	5	W. F. Reynolds, Bellefonte.
5776	Oyster-shell Scale,	7	R. H. Wolf, Sunbury.
5777	Plant Lice,	7	S. J. McClure, Clark.
5780	Larder Beetle,	7	J. H. Hawk, Mercersburg.
5782	Flower Beetle (E. inda),	7	W. S. Bahner, Fisher's Ferry.
5787	San José Scale,	7	A. B. Brackbill & Co., Salunga.
5798	Oyster-shell Scale,	8	N. Dozer, Williamsport.
5800	Oyster-shell Scale,	8	W. W. Wright, Millcreek.
5801	Anthrenus Larvae,	8	Mrs. W. E. Strock, Philadelphia.
5802	Aphids,	8	Dr. J. E. Hostetter, Pequea.
5805	Work of Shot-hole Borers (?),	8	A. W. Young, Manheim.
5806	Moth,	8	J. H. Stiltz, Braddock.
5811	Blackberry Root Cynip Gall,	9	J. E. Bird, Dushore.
5812	Mole Cricket,	9	F. W. Peifer, Fisher's Ferry.
5813	Elm Scale (G. spuria),	9	E. W. Ingram, Oil City.
5814	(a) San José Scale, (b) Lecanium,	9	J. B. Miller, Chambersburg.
5815	Oyster-shell Scale,	9	D. A. Claar, Queen.
5816	Giant Water Bug,	9	R. Davis, Landsford.

Specimens Received During May—Continued.

Number	Specimen—Insects.	Date—May, 1906.	Name and Address.
5817	Oyster-shell Scale,	9	J. F. Wanick, Montrose.
5819	Work of Cicadas,	9	J. A. Runk, Newton Hamilton.
5820	Oyster-shell Scale,	9	J. R. Hunter, Grove Summit.
5821	Oyster-shell Scale,	9	G. Robinson, Seelyville.
5825	Insects,	9	C. Anderson, Harrisburg.
5826	Coleoptera Collection,	9	Rev. G. Brugger, Beatty.
5831	Oyster-shell Scale,	10	H. C. Roth, Reamstown.
5833	(a) Oyster-shell Scale, (b) San José Scale,	11	E. Wells, Wilkes-Barre.
5835	Pine Scale (A. abietis),	11	H. W. Girton, Ridgway.
5837	Beetle pupa,	11	Mrs. S. B. Shulenberger, Heberlig.
5841	(c) Caddis Fly Larva and Cases, (d) Promethea Cocoon, (e) Cecropia Cocoon,	12	A. J. Hanks, Cochrantown.
5843	Oyster-shell Scale,	14	A. J. Hazel, Madisonburg.
5846	Work of Shot-hole Borers,	14	J. J. Tobias, Beavertown.
5849	San José Scale,	14	G. F. Hoy, Hublersburg.
5853	(b) Antlion Larvae,	14	R. D. Spencer, Williamsport.
5854	Work of Shot-hole Borer,	14	P. Eilenberger, Mount Bethel.
5855	Oyster-shell Scale,	14	J. M. Hardeinger, Auburn.
5856	Oyster-shell Scale,	14	O. Bruner, Petersburg.
5858	(a) San José Scale, (b) Oyster-shell Scale, (c) Tent-caterpillar Eggs,	14	G. S. Washburn, McKean.
5859	Wing Termites,	14	E. O. Blair, Waynesboro.
5862	(a) San José Scale, (b) Scurfy Scale,	14	Mr. Haehnlen, Harrisburg.
5863	(a) Cynip Galls on Rose,	14	S. Baldy, Catawissa.
5864	(d) Insects,	14	M. C. Brightbill, Marsh Run.
5867	Oyster-shell Scale,	15	G. W. Day, Steam Valley.
5870	Oyster-shell Scale,	15	J. W. Frye, Oil City.
5871	Oyster-shell Scale,	15	W. H. Bell, Lewistown.
5873	(b and c) Cynip Galls, (d) Oyster-shell Scale,	15	C. E. Denniston, Okome.
5875	Flower Beetle (E. inda),	15	S. K. Brecht, Norristown.
5877	Insects,	15	C. Anderson, Harrisburg.
5879	Insects,	15	H. J. O'Connor, Harrisburg.
5881	Moth Chrysalis,	15	F. S. Henry, Philadelphia.
5885	Work of Shot-hole Borers,	15	R. J. Kise, Stroudsburg.
5886	(a) San José Scale, (b) Oyster-shell Scale, (c) Scurfy Scale,	15	J. Stumb, Richland Centre.
5887	Lecanium,	15	C. B. Pickett, Laceyville.
5889	Oyster-shell Scale,	15	J. H. McClelland, Pittsburg.
5892	Louse Fly from Bittern,	16	R. W. Wehrle, Indiana.
5893	Giant Water Bug,	16	J. S. Miller, Friendens.
5895	Maple Pseudococcus,	16	H. S. Bollinger, Lock Haven.
5896	(a) Lecanium, (b) Oyster-shell Scale,	16	J. Shrawder, Corry.
5897	(a) San José Scale, (b) Oyster-shell Scale,	16	Holmes Seed Co., Harrisburg.
5899	Oyster-shell Scale,	16	J. C. Stoops, Karns City.
5903	Oyster-shell Scale,	16	T. B. Wells, Scranton.
5905	Scurfy Scale,	16	G. Baker, Benton.
5908	Aphids,	16	J. C. Depper, Myerstown.
5909	Flower Beetle (E. fulgida,),	16	C. E. Showalter, Landisburg.
5911	Moths,	16	C. Anderson, Harrisburg.
5912	Slot-hole Borers,	17	W. S. Bahner, Fisher's Ferry.
5914	Weevils from Palestine,	17	Rev. C. Lee, Carbondale.
5915	(a) San José Scale, (b) Lecanium,	17	J. B. Emery, Williamsport.
5919	Plant Lice,	17	J. A. Williams, Sayre.
5921	Insects,	17	C. Anderson, Harrisburg.
5928	The Margined Water Beetle,	18	B. Converse, Granville Summit.
5929	Termites,	18	R. Menges, York.
5933	Work of Shot-hole Borers,	18	P. V. James, Philadelphia.
5935	Louse Fly from Owl, Bird Lice from Owl,	18	T. Doran, Wilmore.
5944	San José Scale,	21	J. M. Karns, Everett.
5947	Promethea Cocoons,	21	J. E. Patterson, Wilkes-Barre.
5952	Oyster-shell Scale,	21	W. J. Petty, Bethlehem.
5953	Oyster-shell Scale,	21	Mrs. L. M. Quinby, Titusville.
5954	7 Mounted Chinese Mantis (T. sinensis.	21	P. Laurent, Philadelphia.
5957	(a) Scurfy Scale,	21	L. Snyder, East Mauch Chunk.
5962	San José Scale,	21	E. C. Tyson, Flora Dale.
5963	Oyster-shell Scale,	22	E. B. Trout, Blandon.
5967	Lecanium,	22	W. P. Tate, Curwensville.
5969	23 Egg Masses (Tenodera sinensis),	22	D. M. Castle, Philadelphia.

Specimens Received During May—Continued.

Number.	Specimen—Insects.	Date—May, 1906.	Name and Address.
5974	Luna Moth,	22	E. W. Cartwright, Grand Valley.
5975	Maple pseudococcus,	22	H. S. Ferry, Mt. Vernon, N. Y.
5976	Oyster-shell Scale,	22	D. C. Bryant, Torrey.
5979	Arctid Moths (B. virginica),	22	M. R. Bower, Landisburg.
5980	(a) Lecanium (L. nigrofasciatum), (b) Maple Aphids,	22	G. W. Snyder, Palmyra.
5981	Lecanium nigrofasciatum,	22	F. H. Goodfellow, Hollidaysburg.
5982	Insects,	22	C. Anderson, Harrisburg.
5989	Corn (?) Weevil (S. sculptilis),	23	W. T. Wood, Doe Run.
5990	Aphids,	23	J. I. Moyer, Birdsboro.
5991	(a) Aphids, (b) Canker Worms, (c) Lecanium, (d) San José Scale,	23	J. H McFarland, Washington.
5992	Radish Root Maggots,	23	M. H. Brandt, Chambersburg.
5996	Apple-leaf Rollers,	23	E. W. Ingraham, Oil City.
5997	Larder Beetle,	24	Mrs. S. Deming, Russel.
5999	Asparagus Beetle,	24	J. C. Withrow, Vanport.
6000	(a) Rove Beetles,	24	J. P. Swoope, Huntingdon.
6302	(d and K) Insects,	24	Dr. O. T. Cruikshank, Swissvale.
6303	Cecropia Cocoon,	24	C. G. Gage, New Milford.
6304	Apple Bud Moth,	25	J. E. Tomlinson, Bradley Junction.
6305	Aphids,	25	L. E. Scherer, Jersey Shore.
6306	Cecidomyia Galls,	25	S. Lick, Marysville.
6307	Lecanium,	25	J. K. McLanahan, Hollidaysburg.
6308	Oyster-shell Scale,	25	M. C. Kennedy, Chambersburg.
6309	(a) Wooly Apple Aphis, (b) Lecanium,	25	J. L. Kalp, Mt. Pleasant.
6313	Solitary Bees,	25	R. L. Jackson, McConnellsburg.
6315	(a) Maple Aphids, (b) Maple Phylloxera,	25	Mrs. A. Leonard, Carlisle Springs.
6316	Ichneumon Wasps (Thalessa lunator).	25	J. Mooney, Conshohocken.
6318	(b) Insects,	25	Mrs. M. C. Brightbill, Marsh Run.
6321	Insects,	25	H. J. O'Connor, Harrisburg.
6329	Scurfy Scale,	28	A. W. Gill, Lewistown.
6330	Lecanium,	28	W. C. Wilson, Cochranville.
6331	(a) Larder Beetle, (c) Thrips,	28	A. Marsh, Kinzua.
6332	Flea Beetles,	28	F. M. Baldwin, Skinners Eddy.
6333	Oyster-shell Scale,	28	D. R. Williams, Danville.
6338	Insects,	28	W. H. Bullock, Honesdale.
6340	May Flies,	28	T. W. Miller, Enhaut.
6341	Giant Water Bugs,	28	Rev. J. C. Fassold, Hughesville.
6344	Mounted Insect Collection (about 75 species).	28	C. F. Laurie, Erie.
6349	Cecropia Moth,	28	A. McHenry, Harrisburg.
6350	Oyster-shell Scale,	29	G. H. Marshall, Tylersburg.
6351	Bloody Leaf Beetle (G. rufosanguinea).	29	J. H. Reynold, Kingston.
6352	Imperial Moth Chrysalis,	29	H. Whipple, Laceyville.
6353	Rose Leaf Cynip Galls,	29	E. W. Fisher, Ambler.
6360	American Water Bug (B. americanum).	29	N. M. Beach, Mansfield.
6361	(a) Scurfy Scale, (b) Roach,	29	S. Stell, Fisher's Ferry.
6362	(a) Twig Borer, (c) Beetle,	29	J. Fryling, Sunbury.
6367	Insects,	29	H. Schick, Harrisburg.
6369	Work of Shot-hole borer,	29	J. A. Clarke, Berwyn.
6375	Maple Pseudococcus,	31	J. Bickell, Jersey Shore.
6377	Mourning Cloak Larvae,	31	D. F. Graham, Harrisburg.
6378	Mole Cricket,	31	C. S. Fouse, Aitch.
6379	Oyster-shell Scale,	31	A. M. Kelley, Huntingdon.
6380	Insects,	31	W. H. Bullock, Honesdale.
6382	Bag Worms,	31	C. M. Drum, Gettysburg.
6383	San José Scale,	31	B. Griffen, Pittston.
	Invertebrates, not Insects.		
5723	(h) Sow Bugs (Crustacea),	1	C. Anderson, Harrisburg.
5727	(c) Crayfish,	1	H. A. Brightbill, Jr., Marsh Run.
5732	Crayfish,	1	H. Barrington, Harrisburg.
5744	(c) Red Mites,	2	B. F. Merrel, Wilkes-Barre.
5768	Nematod Root Galls,	4	Miss M. M. Hildebrant, Mt. Joy.
5822	(a) Millipedes,	9	C. E. Showalter, Landisburg.
5869	Pear-leaf Blister Mite.	15	J. C. Mierley, Alexandria.
5904	Red Mites,	16	W. H. Tritt, Meadville.
6302	(a and g) Crayfish, (c) Earth worms,	24	Dr. O. T. Cruikshank, Swissville.
6328	Squids from stomach of Sea Bass,	26	G. Plummer, Harrisburg.

Specimens Received During May—Continued.

Number.	Specimen—Insects.	Date—May, 1906.	Name and Address.
6339	Shrimp-like Crustacea,	28	A. Erway, Charleston.
6362	(b) Spiders,	29	J. W. Fryling, Sunbury.
6381	(e) Millipede,	31	J. P. Swoope, Huntingdon.
	Amphibians and Reptiles.		
5724	(a) 2 Garter Snakes (T. sirtalis),..	1	R. W. Wehrle, Indiana.
	(b) Hoptoad (B. 1. americana), ...		
5726	Blacksnake (B. constrictor),	1	H. A. Shovlin, Freeland.
5727	(a) Garter Snake,	1	H. A. Brightbill, Jr., Marsh Run.
	(b) Red Salamander (S. ruber), ...		
5748	Hellbender (C. alleganiensis),	2	S. H. Carbis, Rockwood.
5755	House Snake Skin,	3	R. Davis, Lansford.
5772	Garter Snake,	5	W. J. Hunter, Bedford.
5773	Common Swift (Sceloporus undulatus).	5	J. Johnson, Woodbine.
5778	Pilot Snake (C. obsoletus),	7	———, Parnassus.
5783	Ring-necked Snake (D. punctatus),..	7	C. S. Fouse, Aitch.
5786	Garter Snake,	7	Merle Couch, Canonsburg.
5803	Garter Snake,	8	E. Klingaman, Beaver Valley.
5804	(a) House Snake (L. d. var. triangulus),	8	J. Bohn, Onset.
	(b) Red Salamander,		
5822	3 Box Tortoises (T. carolina), ...	9	C. E. Showalter, Landisburg.
	(d) Wood Tortoise (C. insculptus),.		
	(e) Musk Turtle (A. odoratus), ...		
	(f) 3 Granite Salamanders (P. glutinosus.		
5832	Cave Salamander (S. longicauda), ..	10	J. J. Heiserman, Lititz.
5840	Red Salamander,	12	W. Haines, Richhill.
5841	(a) Garter Snake,	12	A. J. Hanks, Cochranton.
	(b) 2 Brown Salamanders (D. fusca).		
5847	Spotted Salamander (A. punctatum),	14	A. J. Hazel, Madisonburg.
5852	(a) Water Snake (N. sipedon),	14	R. D. Spencer, Williamsport.
5863	(b) Pilot Snake,	14	S. Baldy, Catawissa.
5864	(a) Garter Snake,	14	Mrs. M. C. Brightbill, Marsh Run.
	(b) 4 Box Tortoises,		
5868	House Snake,	15	R. S. Davis, Lansford.
5872	Jeffersonian (?) Salamanders,	15	E. R. Mulford, Wellsboro.
5873	(a) 2 Garter Snakes,	15	C. E. Denniston, Okome.
5874	(a) Garter Snake,	15	W. L. King, Bethlehem.
	(b) 5 Land Salamanders,		
5876	Pilot Snake,	15	D. A. Knuppenburg, Lake Cary.
5883	House Snake,	15	C. D. Backenstoe, Fort Hunter.
5888	Red Salamander,	15	D. N. Kern, Allentown.
5906	Common Swift,	16	B. P. Hooke, Jr., Landisburg.
5907	2 Box Tortoises,	16	A. D. Herr, Millersville.
5920	House Snake,	17	Wm. D. Dixon, St. Thomas.
5924	House Snake,	18	J. H. Keim, St. Peters.
5930	(a) 2 Pickering Frogs (H. pickeringii).	18	G. Krautwurm, Pittsburg.
	(b) 2 Common Tree Toads (H. versicolor).		
5931	Purple Triton (G. porphyriticus), ...	18	W. E. Hurd, LaJose.
5932	2 Black Snakes,	18	F. S. Elder, Darlington.
5937	Land Salamander,	18	W. A. Barnes, Gettysburg.
5940	(a) Garter Snake,	19	———, Huntingdon.
5943	House Snake,	19	W. D. Becker, Fleetwood.
5945	House Snake,	21	E. S. Niethamer, Reading.
5946	Water Snake,	21	A. J. Shumaker, Blain.
5948	House Snake,	21	C. U. Swab, Brookville.
5949	Pilot Snake,	21	B. P. Hooke, Jr., Landisburg.
5950	Black Snake,	21	J. B. Gill, Berwyn.
5964	Hellbender,	22	Jos. Schrawder, Corry.
5965	2 Water Snakes,	22	J. Mell, Richland.
5966	Water Snake,	22	E. R. Mulford, Wellsboro.
5973	Red Salamander,	22	E. B. Maule, Cochranville.
5986	Copperhead Snake (A. contortrix),...	23	A. P. White, Lock Haven.
5987	Red Salamander,	23	T. L. Smith, Orson.
5988	Spotted Salamander,	23	W. W. Climenson, Honeybrook.
5998	Water Snake,	24	J. J. Heiserman, Lititz.
6000	(b) Brown Salamander,	24	J. P. Swoope, Huntingdon.
6302	(b) Batrachian Egg Mass,	24	Dr. O. T. Cruikshank, Swissvale.
	(e) Garter Snake,		
	(f) House Snake,		
	(g) 3 Newts (D. viridescens),		
	(h) 2 Cave Salamanders,		
	(i) 47 Brown Salamanders,		
	(l) Nymphs of Brown Salamander,.		
	(m) Nymphs of Desmognathus ochrophaea in Tadpoles of Red Salamander.		

PENNSYLVANIA STATE DEPARTMENT OF AGRICULTURE.

THE MONTHLY BULLETIN

OF THE

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FOR AUGUST AND SEPTEMBER.

VOL. IV. No. 4 and 5. (Combined.)

THE SERPENTS OF PENNSYLVANIA

Issued Monthly from the Pennsylvania Department of Agriculture.
DIVISION OF ZOOLOGY.

PROF. H. A. SURFACE, *Economic Zoologist, Editor.*

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PREFACE.

This Bulletin is issued as a Preliminary Report upon the Snakes of Pennsylvania, with special reference to their Food and Economic Features. It is designed more as a popular treatise upon this subject than as a deep scientific production. Owing to the fact that we could obtain but a few specimens of many of the species of serpents here discussed, and in many cases their stomachs were entirely empty, it is impossible to issue at this time a Report sufficiently full to be called Complete or Final. We are therefore continuing our investigations with all possible care, and as soon as we have sufficient material to justify it, we intend to publish a Second Report, which will contain many scientific features not given in this Preliminary Report. For example, there has been much confusion with the various scientific names for the same species of reptile, and to avoid this our Second Report will contain a full list of synonyms or different scientific names used, as well as bibliography or reference to the literature upon the various species discussed. It will also contain full scientific and popular descriptions of the different species of serpents found in this State, with illustrations of each, and detailed discussions of the variations actually found in a study of the different specimens from the different parts of the State, in comparison with typical specimens and descriptions. This local variation is of considerable interest to the student of species, and will be of great value to scientists as well as to others. It could not be put into this Preliminary Report, because we did not have enough specimens to justify drawing final deductions.

The Second Report will also contain as much as can be obtained from various observers and correspondents upon the haunts and habits of reptiles of this State, and will especially contain larger tables and charts concerning their food and breeding habits. More material is needed to advance these studies. We desire notes or written reports of observations, as well as specimens.

A copy of the Preliminary Report has been promised and is herewith sent to each person who has prior to its publication, sent us one or more specimens or serpents, turtles, lizards, frogs, toads or salamanders. It is hoped that all our obligations are herewith met in full. Persons desiring a copy of the Complete Report are requested to send us more specimens to aid in its completion. These

should be killed and sent by express at our expense or when packages are small by mail, for which postage will be refunded. A copy of the Report will be sent free to each person aiding our investigations by sending us written reports or specimens. The date of issue of the next Report will depend upon the number of specimens received. All persons desiring it are invited to contribute further specimens or written observations.

H. A. SURFACE,
State Zoologist.

Harrisburg, Pa.

ACKNOWLEDGMENTS.

In this Bulletin recognition should be made of the very valuable services rendered by my Assistants, especially Mr. Alfred F. Satterthwait, of Chester county, Clerk in the office of the Economic Zoologist. Mr. W. R. McConnell, Indiana county, Assistant, and Mr. P. H. Hertzog, of Lancaster county, Assistant, have taken great interest in this subject and have rendered valuable help that was essential in working out the details of this Bulletin. To the intelligent and indefatigable industry of Mr. Satterthwait, my clerk for more than a year, much credit is due.

We wish also to recognize the generosity and help that was given us by Mr. W. H. Fisher, 1318 Bolton street, Baltimore, Md., who contributed many of the excellent photographs of the living specimens which are used in making the plates for the Bulletin, and which give it an added interest.

We should also acknowledge the free use that has been made of the "Manual of Vertebrate Animals of the Northern United States," by President David Starr Jordan, and such literature as the publication of "Reptiles of Allegheny County, Pa.," by D. A. Atkinson, in the *Annals of Carnegie Museum*, Vol. I, and the Report of the Amphibians and Reptiles of New Jersey, by Dr. Witmer Stone, Philadelphia Academy of Science, in the *American Naturalist* for March, 1906, and other literature which will be cited in detail in the Second Report.

Acknowledgment should also be made of the assistance of such persons as Dr. Witmer Stone, Philadelphia, Mr. D. A. Atkinson, Carnegie Museum, Dr. R. L. Walker, of Carnegie, Pa., and others. Special mention should be made of the industry and skill of Mr. W. R. Walton, the artist in our office, who has taken an unusual interest in this subject and has been at great pains to have the charts and drawings which were made by him exactly accurate in all their details.

H. A. S.

CLASS REPTILIA. THE REPTILES.

A Reptile may be defined as a cold-blooded Vertebrate, breathing air all its life, never having gills, never using the oxygen in water, with a three-chambered heart, one condyle or lump on the base of the skull, and body covered with scales or plates. Strictly speaking they are not cold-blooded but are of the temperature of the surrounding air or water or objects on which they are found. Experiments in our office, with thermometers inserted in the throats of the reptiles, have shown that the temperature of the animals does not vary much from that of their surroundings.

There are three Orders of Reptiles represented in the State of Pennsylvania, which may be distinguished by the following Analytic Key:

A. Legs not developed. Order I. Ophidia. The Serpents.

AA. Four legs developed.

B. Body elongate, covered with small scales, teeth present. Order II. Lacertilia. The Lizards.

BB. Body shorter, broad, enclosed in a shell; no teeth. Order III. Chelonia. The Turtles.

(N. B. The Lizards and Turtles of Pennsylvania will be discussed in a future Bulletin. Many more specimens are desired. H. A. S.)

ORDER I. OPHIDIA. THE SERPENTS.

Serpents are animals which in their structure show by degradation, a highly specialized type or condition, and yet they are perfectly adapted to the apparently lowly life they lead.

Ignorance, mythology and superstition have combined to surround them with an atmosphere of dread. It is not only superstition but also ignorance and unnecessary fear which have rendered it impossible for many persons to study them carefully. As a consequence there are no other group of animals in this State concerning which there is so much fear and ignorance, and toward which there is so much cruelty almost uniformly shown in a relentless and unjust warfare.

Among the myths, fallacies or folk lore of serpents current in some parts of this State are the following:

1. Snakes sting with their tongues.
2. Snakes charm birds and people.
3. The green serpents are venomous.

4. There is such a creature as a Hoop Snake; which rolls like a hoop.

5. There is a Horn Snake, with a venomous horn at the end of its tail.

6. Snakes are blind once per month, and regularly during "dog days."

7. Snakes molt or shed their skin each month.

8. Serpents can blow out or spit poison.

9. Snakes chase and attack people without provocation.

10. Serpents and other reptiles are slimy.

11. Certain kinds of snakes milk or suck cows.

12. When snakes are killed the tails do not die until the sun goes down or until it thunders.

13. Kill a snake and turn it over to bring rain.

14. Snakes spring or jump from the ground at their victims.

15. Snakes strike from a truly coiled position.

16. When a firearm is pointed at the snake the reptile draws its own bead and it is impossible to miss it or shoot it anywhere but in the head.

17. The yellow rattlers are females and the black, males.

18. A snake can be made to put out its legs by dropping it into fire.

19. Snakes lose their venom by being deprived of water for six days or more.

*20. Snakes are supposed to have medicinal properties as follows:

(a) Galls of snakes recommended for their bite.

(b) Their oil for rheumatism, baldness and deafness.

(c) Their skin worn for rheumatism and stiffness.

(d) A snake heart, oil or blood for consumption or other ills.

(e) Its flesh to be eaten for blood disorders or other troubles.

(f) A second bite of the same snake in the same place to cure or counteract its first bite.

(g) The rattles of snakes as charms.

(h) Other parts of serpents for various cures, preventives or charms.

The myths concerning serpents are numerous, and new bits of local folk lore of reptiles come to us every week. For example, it is a popular belief that snakes sting with the tongue. This may be due to the Scriptural expression, "stingeth like an adder." The Scripture did not say the stinging is done by the tongue, or is not done by the tooth, and the reader at once infers that the tongue is the stinging organ, and thus falls into a serious error.

*Since this Bulletin was set in type we have heard of the common belief that Snakes, Lizards, Frogs, Salamanders, etc., live in the human stomach. After many efforts this belief can not be verified, and we consider it a decided error.—H. A. S.

The tongue of the snake is its organ of touch, taste and perhaps in part also of smell, and possibly even of hearing. It is by this that it investigates the objects immediately around it. When it is seen to stick out its tongue it is making a critical inquiry of the surrounding objects and is not attempting to sting anything.

It is also popularly believed that snakes have the power to charm birds and the lower animals and even mankind, but with the most careful investigation, we can not find satisfactory evidences of the truth of this. It is true that some creatures, such as birds, and even some persons, become so terrified at suddenly seeing a snake that they act more or less helpless but this is quite different from being charmed.

Another common error is the belief that the green snakes are venomous because they are supposed to be filled with a poison that makes them look green. Of the three or four species of green snakes to be found in this State not one is of a dangerous type.

The old story of the Hoop Snake, which is supposed to take its tail in its mouth and roll down hill like a hoop, striking dead anything into which that venomous horn may fly, is very common but entirely without any foundation of truth. No specimen of Hoop Snake has been collected, notwithstanding an offer of a reward of $500.00 for one. Persons who believe such things have not considered that this habit would result in bringing all such reptiles down into the valleys where they must be found, as they would be unable to roll up hill again. Who will say he has seen a Hoop Snake rolling?

The Horned-snake is another myth, and although it has formed the basis for many newspaper stories, it has no truth. While there is a snake to which there is given the name of "The Horned Snake," it is quite harmless, and there is no such reptile as the mythological creature with a poisoned horn in the end of its tail, which it is able to stick into living objects, even trees, causing death or even milder injury, which is an absurd story frequently published. We shall pay well for specimens of Hoop Snakes or Horn Snakes.

No snakes are able to eject, throw or "spit" poison, nor by their blowing or hissing are they able to blow any poison or venom upon their victims. This is generally believed, notwithstanding the facts to the contrary.

A common error is the term "slimy," applied to serpents and other reptiles. Snakes are not slimy, nor are their bodies naturally moist, being covered with dry scales. One of the easily recognized differences between Lizards, which are Reptiles, and Salamanders, which are Amphibians, is that the latter are slimy and the former are not.

Another common belief is that the constricting species of ser-

pents wrap themselves around the necks of human beings and choke them. All stories of this kind, so far as we have been able to learn by the most careful investigation, are the results of active imaginations. Even the stories of snakes chasing people are, as a rule, generally exaggerated. It is true that blacksnakes will sometimes pursue timid persons who have disturbed them. That seems to be one of Nature's bluffs however, as the same reptiles will turn tail and depart in the most vigorous manner possible, when the pursued person has the courage to turn on it. Even if they do chase a person, they will not overtake nor attack him.

Among the myths must be classed the common belief that snakes milk or suck cows. This feat is not possible, and in our honest opinion never was performed. A recent newspaper article gave the name of a Connecticut farmer who was reported as having seen the Milk Snake sucking his cattle. We wrote to him for details, and he replied "A reporter lied about me."

How common is the absurd belief that a snake's tail does not die until sundown or until it thunders! When we were at home with the country boys we firmly believed with them that to kill a snake and turn it upside down would bring rain. Who knows other beliefs of this kind which they are willing to mail to us for our collection of literary curiosities?

Another popular erroneous belief is that snakes jump or spring from the ground at their victims. No snake is able to jump or spring but merely strikes from its zigzag coil, which is like the letter "S" placed horizontally. It can then only reach the distance that it is able to strike out from this double curve, which is rarely more than half the length of its body, and probably never more than three-fourths of its total length. No snake springs clear from the ground as it strikes, and none jumps through the air to its victim, although occasionally the blow may be delivered with such force as to turn the reptile over.

It is also believed by some persons that serpents coil in a regular manner, like the coil of a rope, and strike from such a coil. We have seen mounted specimens and drawings representing snakes coiled like a rope and ready to strike at their supposed victims, but these do not represent the truth. If a serpent should attempt to strike from a uniform coil, like a pile of rope, it would be obliged to turn over as many times as it was coiled, in order to make a straight line to the intended victim. While reptiles do coil partially, they keep the front part of the body free for striking from a zigzag or horizontal letter "S" position. It should also be remembered that no serpent can strike while stretched out or in an extended position.

A common belief is that when a gun or pistol is pointed toward a snake, the reptile puts its head in such a position as to draw the "bead" or line of sight to its own head, and thus it is thought to be impossible to shoot at a serpent which sees the weapon without hitting it. This is false, as we have seen demonstrated. Also it is commonly said that it is impossible to shoot a snake in any part excepting the head, on account of the common belief that the eye of the reptile keeps in line with the sites of the weapon. We have known where rattlers and other serpents have been shot through the body and not through the head, and this proves the error of another myth.

It is also commonly said that the yellow color of the Rattle Snake denotes a female individual, while the black color always indicates a male. Our dissections have proven that this is not always the case, although these colors appear to predominate or be more common in each sex respectively.

From ancient times until the present there has been a common saying that snakes can be made to throw out their legs by dropping them into a fire. This is purely a myth and without any other foundation than the probability that the sudden contraction of the muscles of the body may force out certain internal organs.

We have recently learned that there is a common saying in the northern part of the State that if a rattle snake or a copper head be deprived of water for six days they will lose their venom, or in other words their poison becomes ineffective. There is no truth in this for the tendency would be to make the poison stronger rather than less efficient.

There is a general belief in the medicinal qualities of certain parts of snakes. It is enough to say that these are founded in superstition, and that no part of any serpent has any medicinal value. Nevertheless we frequently hear of a person recommending such remedies as the gall of a snake for snake bite; its oil for rheumatism, baldness and deafness; and its skin to be worn like the skin of an eel for similar troubles. It is a remarkable fact that in some parts of this State the oil of snakes has a very high commercial value for its supposed curative qualities. It is thought to be a sovereign remedy for deafness, but there is no reason why this is any better than any other oil. We have recently learned of the heart of a Rattle Snake being swallowed while fresh for consumption, and the flesh and blood have been recommended for certain ills. It is also generally believed, not only in America but in other parts of the earth that if a snake can be made to bite a second time in the same place it will, by so doing, cure the ills inflicted by its first bite. This is, of course, nonsense, as are the

other superstitious beliefs and quack remedies above outlined. No snake and no part of any snake has any curative or medicinal quality whatever, and persons who trust in them are doing so at the peril of their own welfare.

We recently learned that a family in Lancaster county took a long journey into Schuylkill county to obtain the oil of a rattle snake to mix with whiskey as a remedy for consumption. In this particular instance the person who was afflicted with the disease did not recover, and this is a proof of the ineffectiveness of such quack remedies.

Queer Facts.

1. Some serpents swallow their young for temporary protection.
2. Some snakes play "possum," or act dead, as a means of defense.
3. Some snakes lay eggs; others bear young.
4. Fangs of serpents are renewed or grow in again after being extracted.
5. The young Black Snake is gray and spotted and often mistaken for the Spotted Adder, Water Snake or Copperhead.
6. Snakes can live a year or more without food.
7. Serpents often eat one another.
8. Some species of snakes are beneficial as insect-eaters and others as destroyers of mice and other obnoxious rodents (mice, rats, etc.).
9. Two-headed snakes are not uncommon.
10. Snakes and other reptiles are not "cold-blooded," but are the temperature of their surroundings.

Concerning serpents there are many things that are true which are as interesting, and in fact as marvelous, as the many myths that are generally accepted. Among these is the fact that some snakes are known to swallow their young for temporary protection as has been observed and reported to us by several reliable persons. While we have not been so fortunate as to have observed this personally, yet we can not deny that certain species of snakes afford temporary refuge in time of danger to their own young, which run down the throat of the parent. It is not known as yet just what species or kinds of snakes have this habit and what do not, but it is known to be true of the Garter Snake and probably also of the Water Snake. Prof. W. L. MacGowan, superintendent of the schools of the city of Warren, reported to us that he had seen a Garter Snake swallow her young for protection no less than four times in his life, and an Erie county school teacher reported that an old Garter Snake with her family of young lived under a bank

on the hill near the school house and nearly every day at noon some of the pupils would go up the hill and frighten the old Garter Snake to see the young ones run down her throat. She would then go into a hole and no doubt permit them to escape at once from their living cell.

Professor MacGowan said that in those which he had observed the young remained in the body of the parent about five minutes. It is probable that this habit is confined mostly, if not entirely, to those species of serpents which bear young rather than reproduce by laying eggs. We wish to make further observations along this line and consequently request readers to send us for dissection recently killed specimens of all kinds that may be suspected of having swallowed their young for protection.

Few people know that the Hog-nosed Adder or Blowing Viper has the habit of acting dead or "playing possum" when it thinks there is no other means of escape. This peculiarity is described more at length in one of the following pages.

It does not appear to be generally known that the fangs of serpents when pulled or drawn to render them harmless, will develop and become dangerous again within a few weeks after pulling. If these be drawn, others will grow again, and this will be repeated several times. It is lack of this knowledge which sometimes results in injury for persons who have pulled the fangs of venomous serpents and then considered themselves safe to keep them as pets for some time.

There is a great variation in the colors of snakes, and but few persons know that the young Black Snake is light in color and spotted with gray in such a manner as to be mistaken frequently for the Spotted Adder or House Snake and sometimes for young Copperheads.

The fact that serpents are able to live a year or even more without food is demonstrated in a specimen of Copperhead which we have recently received and which before being sent to us was kept for a year and three months without eating any of the food that was offered to it. It is also interesting to know that snakes are cannibals, as some kinds at times devour individuals of other species.

In the text books, snakes and other reptiles are called cold-blooded and there is a common impression that they are truly so, but the fact is that these animals are the temperature of their surroundings. We have tested this several times recently with a thermometer and can say that the temperature of such serpents does not differ from that of its surroundings where it has remained long enough to become of the same temperature.

Molting or Shedding, and Color.

It is often believed that snakes go blind during dog days, and that they are blind once each month at the least, and that molting or casting off the skin occurs each month, etc. There is just enough truth in this belief to keep it in existence. Snakes do molt or cast off the epidermis, or outer skin which becomes dry or hard, and without being shed or cast off the owner could not grow. This molting is generally not more than two or three times a year and depends on the rate of growth of the reptile, which, in turn, depends upon the supply of food. At such times the clear glassy cuticle which passes over the eye, without an opening, becomes loosened from the eye and assumes a milky appearance. It is then that the snake is temporarily blind but only for a short time.

The color of snakes varies greatly, even in the same species and depends more upon the stage of molting than upon anything else. The snake which has recently shed its skin has very bright colors, and as it becomes older it becomes darker and duller in appearance. This molting take place by the outer skin becoming loosened around the lips and turning backward inside out. Sometimes the entire "skin," or epidermis, is left whole or unbroken. However, at the tip of the tail, around the eyes, and around the mouth, can be seen very plain evidences that it has been turned inside out in the process of shedding. This provides not only for a new coat but especially for the growth of the former wearer.

How Snakes Feed.

The method of feeding is very peculiar and interesting, as they frequently swallow objects which are much larger around than themselves. They are the only creatures which are able to do this. This possibility is due to their being provided with an extra bone called the Quadrate bone, hinging between the upper and lower jaws, which makes it possible for the mouth to open to an extreme extent, while the lower jaw itself will separate at the front edge by spreading sidewise, allowing the jaws to spread open in two directions when necessary. In capturing their prey, some species, known as the constrictors, squeeze it until it is killed and then proceed to swallow it. Others strike their food and hold it, and by an imperceptible movement of the jaws they gradually work it around so they can swallow it lengthwise. Some species of the poisonous reptiles may strike their prey with the poison fangs and thus kill it before eating, but when it is possible they avoid wasting the venom and do not kill their food by poison before eating. It should here be added that the venom of the two venomous species in this State,

the Rattle Snake and the Copperhead, is not an internal poison, or is not injurious if taken inwardly (unless an internal scratch should let it into the blood), and its fearful effects occur only when the poison is injected into the blood system.

Some of the serpents which kill their prey before eating, cover it with a slime before swallowing, if it be of large size. We know definitely of snakes covering rabbits with slime before attempting to swallow them. It is probable that only those animals which are covered with hair or feathers, or are very dry, like the toad, are thus treated before they are swallowed.

How Snakes "Run" or Move.

A serpent literally walks on the ends of its ribs. That is to say, the ribs are jointed to the back bone, and as they extend down over each side of the body their ends are in connection with the ventral plates, which have projecting edges at their rear margins. As these plates hold to the objects beneath the animal its body is brought forward upon the supporting and movable ribs. In this method of locomotion is to be found the explanation of why snakes can not run on smooth glass nor upon such objects as brussels carpet. Glass is so smooth that the ventral plates are unable to hold to it, and after they have been thrown forward the animal can not carry itself along. In attempting to crawl on brussel carpet the surface of which is composed of small upright stiff threads, the piling springs backward by the pressure of the ventral plates when the reptile attempts to move itself forward, and it thus fails to find a leverage, just as upon the smooth glass.

Do Snakes Lay Eggs?

This is a question commonly asked, the answer to which many persons do not understand. It is known that some species of serpents lay eggs, as farmers often plow them up and upon opening them they find the embryonic snake within the leathery covering. The eggs of the same species vary in size and shape, but are almost always oval in outline, and covered with a thick, soft, pliable, light-colored leathery membrane. As a rule, it is the constricting snake, or those which kill their prey by squeezing it, that lay eggs. However, there are other species of snakes that bear living young, or more strictly, give birth to young which are enveloped in a very thin membrane at the time they are born, and thus their method of reproduction is to be compared to the laying of an egg which hatches the time it is laid. The egg-laying species are called oviparous, and those species that bear living young are called ovovi-

viparous. Scientists make a distinction between those animals bearing living young which represent the laying of an egg that hatches at the time it is laid, and those bearing young which have been nourished by direct connection with the circulatory system of the parent. An animal with the former method of reproducing the young is called ovoviviparous. In this the embryo or undeveloped young is nourished by a yolk within the thin membrane, and this embryo remains and develops until the yolk is all absorbed, when it is practically hatched and born at the same time. There is no vital nourishing connection as in the case of the viviparous animal, such as the mammals or hairy quadrupeds. With this explanation we can say that snakes are oviparous or ovoviviparous, and are not to be called viviparous, although bearing living young. In this State no reptile produces more than one brood of young per year. The oviparous or egg-laying species, as a rule, produce many more offspring in a brood than do the ovoviviparous species of the same size. One reason for this is that with the latter the young are much larger than the eggs would be, and occupy a great deal more space. Thus, in making provision for the increased size of the undeveloped young, the only thing that nature can do is to reduce the number.

The relationship, which we believe only general, but of which we have seen no published statement, is that most of the oviparous or egg-laying species of serpents belong to the constricting group, which kill ther prey by squeezing it; while most of the ovoviviparous serpents are species which take their prey with their mouths, and do not kill by constricting. The explanation for this may be that if the serpents of the latter group should exert pressure sufficient to kill their victims it would also crush the embryos or undeveloped snakes, which are protected only by a thin membrane. Thus the constrictors, like the Black Snakes, lay eggs that are covered with thick protecting membranes, which are soon laid, and the embryos of which are not injured by the pressure which is often needed for the parents to kill their prey.

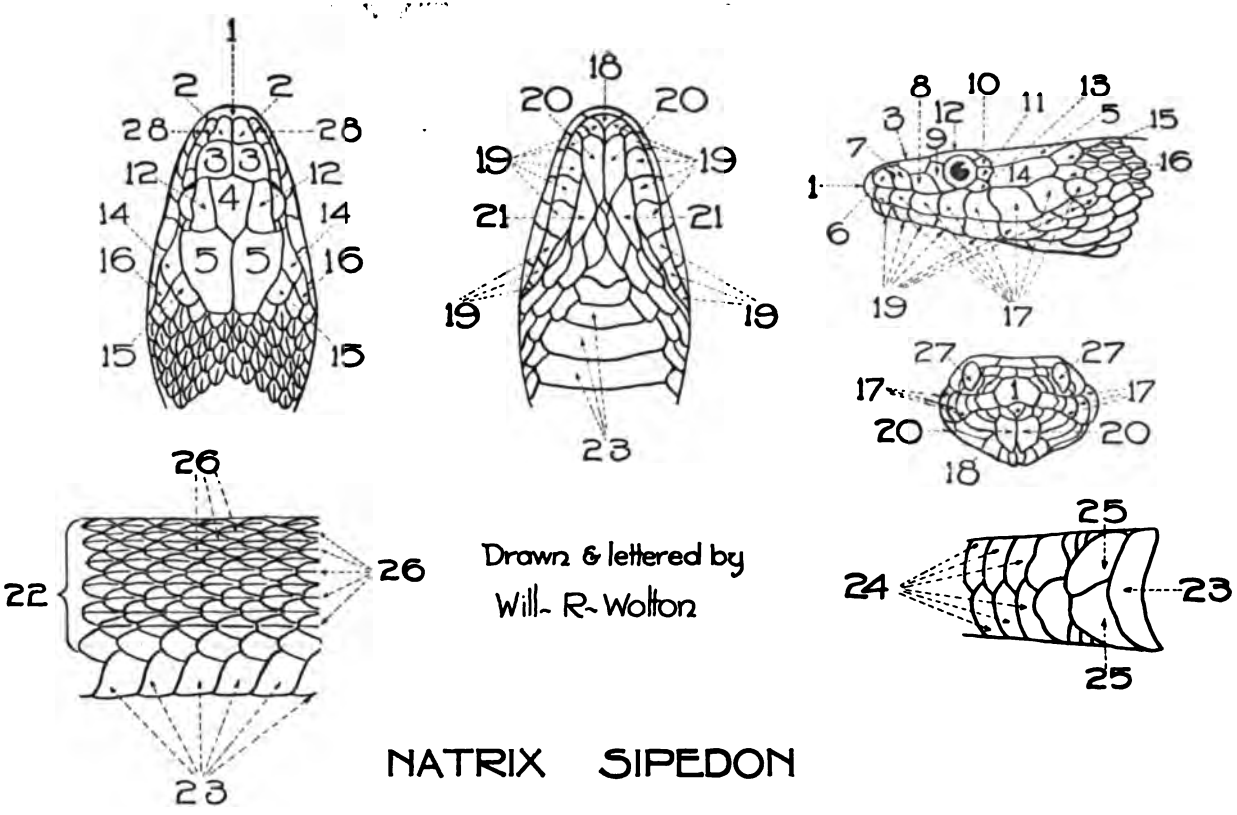
Remedies for Snake Bites.

Remedies for snake bites are of considerable importance, as it must be remembered that two venomous snakes, the Copperhead and the Rattler, are abundant in certain parts of this State, and even during this summer there have been reports of human beings dying from the bites of rattlers as well as copperheads within the Commonwealth of Pennsylvania. We have verified these reports by correspondence and must recognize their accuracy.

When a person is bitten by a venomous snake the first thing to do is to place a ligature as tightly as possible between the wound

and the heart to keep the poison from being carried to the heart in the circulatory system. This can often be done by tearing some article of clothing into strips, tying it tightly around the bitten member between the bite and the heart, and twisting it as tightly as possible with a stick put through the band of ligature. The next step is to suck or squeeze out all the poison possible. This is greatly aided by opening the wound with a knife or other sharp instrument. The third step is to rub permanganate of potash into the wound. This is the best possible remedy for snake bites, and in places where venomous snakes are found permanganate of potash should be at hand ready for immediate use by any one who is exposing himself to their attacks. It is well for persons on fishing or berrying expeditions, or on outings, to carry with them some of this material, which is very inexpensive, and is easily carried wrapped in paper. No evil effects to the human system will come from using too much of it, and thus it is perfectly safe in the hands of an unskilled person. The fourth and last step in the treatment of snake bites it to give a good heart stimulant, the best of which is the injection of one-twentieth of a grain of strychnia. Most cases of death or serious results from snake bites are due to the effects of the poison on the heart, and this is why whisky is so often regarded as a sovereign remedy. It is entirely wrong for a person who is bitten by a venomous snake to fill himself with whisky and expect this to be the only remedy necessary. In most cases it may be a decided help, but it should be a last resort rather than a first. Wherever it is possible the services of a physician should be secured, although the treatment mentioned above should be given as far as possible as soon as the poison has been injected. It is useless to depend upon some of the reputed remedies, such as the gall of the snake taken internally, or a second bite by the same snake at the same place, or powwows of any kind. Prompt action and common sense will do more to prevent evil effects from snake bites than anything else.

We wish here to call attention to the idiotic practice of some persons who try to be smart by frightening others with snakes, whether they be dead or alive, harmless or otherwise. Severe punishment should be administered to the boy who attempts to frighten others, especially girls, with snakes however small or harmless they may be. While the fear of snakes is generally based on ignorance, we should respect the feelings of others and remember that serious results may come from being thus frightened. One example should be enough to put an end to this practice forever. Some years ago some school children were playing in a school yard near the centre of this State and the boys found a small snake. There



NATRIX SIPEDON

PLATE XV.—Showing Structural Characters Used in the Classification of Serpents, as Illustrated by the Spotted Water Snake (*Natrix sipedon*).

1, Rostral plate; 2, Internasal plates; 3, Prefrontal plates; 4, Frontal plate; 5, Occipital plates; 6, Anterior nasal plates; 7, Post nasal plates; 8, Loral plates; 9, Preorbital plates; 10, Upper postorbital plate; 11, Middle postorbital plate; 12 Superciliary plates; 13, Lower postorbital plate; 14, Temporal plates; 15, Upper post temporal plates; 16, Lower post temporal plates; 17, Upper labial plates; 18, Mental plate; 19, Lower labial plates; 20, Anterior inframaxillary plates; 21, Posterior inframaxillary plates; 22, Scales, or "Dorsal Scales;" 23, Gastrosteges, or "Ventral Plates;" 24, Urosteges or "Tail Plates;" 25, Anal plate (Divided); 26, Keels on scales; 27, Eyes; 28, Nostril. Natural Size. Drawn in the office of the Economic Zoologist.

PLATE XVI.—Ground Snake (*Carphophiops amœnus*).
Photographed alive and in Natural Surroundings by Mr. Wm. H. Fisher, Baltimore, Md.

PLATE XVII.—DeKay's Snake or Rock Snake (*Storeria dekayi*).
Photographed alive and in Natural Surroundings, by Mr. Wm. H. Fisher, of Baltimore.

PLATE XVIII.—Ribbon Snake (*Thamnophis saurītus*).
Photographed alive and in Natural Surroundings, by Mr. Wm. H. Fisher.

was one boy in the group who was inexpressibly afraid of such creatures, and to tease him the boys threw it at him. It wrapped itself around the neck of the timid boy, while he fell to the ground in a faint. It was regarded for a moment as a great joke, but as the boy did not recover readily it became more serious. That boy is to-day a raving maniac in one of the insane asylums of Pennsylvania. He was at one time a bright and happy boy, and had it not been for the thoughtlessness of his companions he might have been to-day a most useful citizen instead of a man with dethroned reason.

KEY TO PENNSYLVANIA FAMILIES OF THE ORDER OPHIDIA.

A. No pit between the eye and nostril; pupil of eye circular; no erectile fang nor poison gland in upper jaw; plates under tail divided by a middle line; body generally slender and tail long. Family 1. Colubridæ. Colubrine or Constricting Snakes.

AA. Pit between the eye and nostril; pupil of eye vertically elliptical; erectile fangs with poison glands in each upper jaw; plates under tail (urosteges) not divided by line, but extending clear across; body always heavy and tail always short. Family 2. Crotalidæ. The Rattle Snakes and Copperheads. (Page 185.)

Family 1. *Colubridæ.* The Colubrine or Constricting Snakes.

This is the family to which all serpents of this State belong except the Rattle Snake and the Copperhead, which belong to the Crotalidæ. (Page 175). The Colubrine Serpents, or members of this Family, can be known by (a) entire absence of the perforated fangs, (b) only solid teeth present in the upper jaw, (c) no poison or poison glands, (d) the subcaudal plates (urosteges) arranged in pairs by being divided along the middle line under the tail by a line or suture, (e) no pit between the eye or nostril, (f) the pupil of the eye always circular in shape, and (g) the tail always as large as the length of the body.

They do not all attack their prey by constricting or squeezing, but all the constrictors belong here. It is a large family, with over 700 known species, found in nearly all parts of the world. There are about 21 species of this family to be found in this State. Some of them are oviparous, and some ovoviviparous, or bear young nourished by a yolk enclosed in a thin membrane. The habits of each will be discussed in turn under its own specific name.

KEY TO THE SPECIES OF COLUBRIDÆ OR COLUBRINE SNAKES IN PENNSYLVANIA.

(a). SYSTEMATIC STRUCTURAL KEY.

1. Head not distinct from body, which iscylindrical and rather rigid. 2.
   Head more or less distinct from body, which is not especially rigid. 3.
2. Scales in 13 rows; Nasal single. No.1. *Carphophiops amœnus* (Say). Page 133.
   Scales in 15 rows; Nasals two. No. 2. *Virginia valeriæ* (B. & G.) Plate XV.
3. Rostral plate normal, not recurved nor keeled. 4.
   Rostral plate long, upturned. No. 21. *Heterodon platirhinus* (Latr.) Page 180.

4. Anal plate divided. 5.
   Anal plate not divided. 17.
5. Dorsal scales keeled more or less. 6.
   Dorsal scales not keeled. 15.
6. Nostril between two nasal plates. 7.
   Nasal single, pierced by nostril. 14.
7. Prefrontals two. 8.
   Prefrontal single. No. 3. *Haldea striatula.* (L.) Plate XV.
8. Loral plate present. 9.
   Loral plate absent. 13.
9. Scales on back and sides all keeled. 10.
   Scales on sides not all keeled. 12.
10. Scales 19 to 21 rows.
    Scales in 23 rows. No. 11. *Natrix sipedon* (L.) Page 152.
11. Without yellow lateral stripe; lower row of scales smooth. No. 9. *Regina rigida* (Say). Page 150.
    With yellow lateral stripe; Scales all keeled. No. 10. *Regina leberis* (L.) Page 150.
12. Scales in 27 rows. No. 12. *Callopeltis obsoletus* (Say). Page 157.
    Scales in 25 rows. No. 13. *Callopeltis vulpinus* (B. & G.) Page 161.
13. Scales in 15 rows. No. 4. *Storeria occipitomaculata.* (Storer). Page 136.
    Scales in 17 rows. No. 5. *Storeria dekayi* (Holbr.) Page 138.
14. Scales in 19 rows. No. 6. *Clonophis kirtlandi* (Kenn). Page 140.
    Scales in 17 rows. No. 14. *Opheodrys aestivus* (L.) Page 162.
15. Nasal single. No. 15. *Liopeltis vernalis* (DeKay). Page 164.
    Nasals two. 16.
16. Head flat, preoculars equal in size. No. 18. *Diadophis punctatus* (L.) Page 171.
    Head not degressed; upper preocular larger than lower. No. 16. *Bascanion constrictor.* (L.) Page 166.
17. Dorsal scales all or part of them keeled. 18.
    Dorsal scales not keeled. 20.
18. Scales 29. No. 17. *Pituophis melanoleucus* (Daudin). Page 171.
    Scales 19.19.
19. Lateral stripes on 3rd and 4th rows of scales. No. 7. No. 7. *Thamnophis saurita* (L.) Page 141.
    Lateral stripes on 3rd and 4th rows of scales. No. 8. *Thamnophis sirtalis* (L.) Page 143.
20. Ventral plates 210 to 240, chiefly black with yellow lines. No. 19. *Lampropeltis getulus.* (Say). Page 174.
    Ventral plates 180 to 210, grayish with black borders around brown blotches. No. 20. *Lampropeltis doliata var. triangulus* (Bole). Page 174.

(For the Key to Crotalidæ or the Venomous Snakes, see page 186).

(b). SIMPLE STRUCTURAL KEY.

A. Scales not keeled, or AA.
B. Anal plate bifid or divided, or BB.
C. Scales in fewer than 20 rows, or CC.
D. Scales in 13 rows. No. 1. Ground Snake. Page 134.
DD. Scales in 15 to 17 rows.
E. Ventral plates not as many as 165, or EE.
F. Ventral plates about 120. No. 2. Valeria's Snake. Page 135.
FF. Ventral plates about 140.
G. Blackish, with yellow collar. No. 18. Ring-necked Snake. Page 171.
GG. Green, no collar. No. 15. Grass Snake. Page 164.
EE. Ventral plates more than 165, about 185. No. 16. Black Snake. Page 166.
CC. Scales in 25 or 27 rows. (Middle scales slightly keeled.)
D. Scales in 27 rows. No. 12. Pilot Snake. Page 157.
DD. Scales in 25 rows. No. 13. Fox Snake. Page 161.
BB. Anal plate entire.

C Ventral plates 210 to 240. No. 19. King Snake. Page 174.
CC. Ventral plates 180 to 210. No. 20. Milk or House Snake. Page 174.
AA. Scales keeled.
B. Anal plate entire, or BB.
C. Scales 29. No. 17. Pine Snake. Page 171.
CC. Scales 19. (The Garter Snakes; Thamnophis). Page 141.
D. Lateral stripe on third and fourth rows of scales. No. 7. Ribbon Snake, Striped Garter Snake.. Page 141.
DD. Lateral stripe on second and third rows of scales. No. 8. Garter Snake, Common. Page 143.
BB. Anal plate bifid or divided.
C. Scales in fewer than 20 rows, or CC.
D. Scales in 15 to 17 rows, or DD.
E. Green; tail 1-3 of length. No. 14. Green Snake. Page 162.
EE. Brownish (never green); tail not 1-3 length.
F. No black dots on back; loral plate present. No. 3. Brown Snake. Page 135.
FF. Black dots on back; no loral plate.
G. Scales in 15 rows. No. 4. Red-bellied Snake. Page 136.
GG. Scales in 17 rows. No. 5. Rock Snake. Page 138.
DD. Scales in 19 rows.
E. Spots both above and beneath. No. 6. The Red Snake. Page 140.
EE. Stripes but no spots.
F. Lower row of scales smooth. No. 9. Rigid Queen Snake. Page 150.
FF. Scales all keeled. No. 10. Striped Water Snake. Page 150.
CC. Scales in more than 20 rows.
D. Snout not flat, pointed nor keeled, or DD.
E. Ventral plates fewer than 160. No. 11. Spotted Water Snake. Page 152.
EE. Ventral plates more than 200.
F. Scales in 27 rows. No. 12. Pilot Snake. Page 157.
FF. Scales in 25 rows No. 13. Fox Snake. Page 161.
DD. Snout flat, pointed and keeled. No. 21. Spreading Adder. Page 180.

(For the key to our species of Crotalidæ—Rattlers and Copperheads—see Page 186.

(c). COLOR KEY FOR PENNSYLVANIA SNAKES.

1. Without fangs; no pit between eye and nostril. 2. Family 1. Colubridæ.
   With fangs, and pit between eye and nostril. 25. Family 2. Crotalidæ.
2. Body uniformly colored above, without other markings. 3.
   Body with spots or stripes above 8.
3. Color brown. 4.
   Color greenish or black. 5.
4. Scales not keeled—smooth. No. 1. Carphophiops amœnus (Say). Ground Snake. Page 134.
   Scales keeled—rough. No. 3. Haldea striatula (L.) Brown Snake. Page 135.
5. End of snout pointed and upturned. No. 21. Heterodon platirhinos (Latr.). Spreading Adder. Page 180.
   End of snout not pointed nor upturned. 6.
6. Color green or greenish. 7.
   Color black or bluish black. 6a.

6a. Belly slaty blue. No. 16. Bascanion constrictor (L.). Black Snake, Page 166.
   Belly with dark blotches. No. 12. Callopeltis obsoletus (Say). Pilot Snake. Page 157.

7. Scales smooth. No. 15. Liopeltis vernalis (DeKay). Grass Snake. Page 164.
   Scales keeled. No. 14. Opheodrys æstivus (L.). Green Snake. Page 162.
8. Tip of snout upturned. No. 21. Heterodon platirhinos (Latr.). Spreading Adder. Page 180.
   Tip of snout not upturned. 9.
9. Top of head bright copper-colored. No. 13. Callopeltis vulpinus (B. & G.).

Fox Snake. Page 161.
Top of head not coppery. 10.

10. Belly reddish or salmon-colored. 11.
Belly not reddish. 13.

11. Uniform color below, without markings. 12.
With two rows of black spots below. No. 6. Clonophis kirtlandi (Kenn.). Little Red Snake. Page 140.

12. Three pale spots on back of head; scales keeled. No. 4. Storeria occipitomaculata (Storer). Red-bellied Snake. Page 136.
Yellow band around neck; scales smooth. No. 18. Diadophis punctatus (L.). Ring-necked Snake. Page 171.

13. Stripes above, but no large spots nor blotches. 14.
Above with stripes and spots or spots alone. 18.

14. Yellowish below. 15.
Greenish below. 16.

15. Belly with two brown bands; lower row of scales smooth. No. 10. Regina leberis (L.) Striped Water Snake. Page 150.
Belly blotched; scales all keeled. No. 9. Regina rigida (Say). Rigid Queen Snake. Page 150.

16. Dots bordering dorsal stripes. No. 5. Storeria dekayi (Holb.). Rock Snake. Page 138.
Dots not bordering dorsal stripes. 17.

17. Lateral stripe on third and fourth rows of scales. No. 7. Thamnophis saurita. (L.). Ribbon Snake. Page 141.
Stripe on second and third rows of scales. No. 8. Thamnophis sirtalis (L.). Garter Snake. Page 143.

18. Scales smooth. 19.
Scales rough. 21.

19. Markings grayish with scattered minute black dots. No. 2. Virginia valeriæ. (B. & G.). Valeria's Snake. Page 135.
Markings in the form of spots or blotches. 20.

20. Black, with small yellowish spots or narrow yellowish lines. No. 19. Lampropeltis getulus sayi (Holb.). King Snake. Page 174.
Grayish, with brown blotches. No. 20. Lampropeltis doliatus triangulus (Boie). House Snake. Page 174.

21. Spots not distinct; blackish; scales white-edged. No. 12. Callopeltis obsoletus (Say). Pilot Snake. Page 157.
Spots distinct. 22.

22. Ground color whitish. No. 17. Pituophis melanoleucus (Daudin). Pine Snake. Page 171.
Ground color dark. 23.

23. Belly blotched. No. 11. Natrix sipedon (L.). Spotted Water Snake. Page 152.
Belly not blotched. 24.

24. Stripes and squarish spots. No. 8a. Thamnophis sirtalis sirtalis (L.). Striped Garter Snake. Page 141.
Spots, but no stripes. No. 8b. Thamnophis sirtalis ordinatus (L.). Spotted Garter Snake. Page 143.

25. With no rattles at end of tail. No. 22. Agkistrodon contortrix (L.). Copperhead Snake. Page 186.
With rattles at end of tail. 26.

26. Blotches on back in seven series; rattles small. No. 23. Sistrurus catenatus (Rafin.). Prairie Rattle Snake. Page 190.
Blotches on back in three rows, forming zigzag cross-blotches; rattles large No. 24. Crotalus horridus (L.). Common Rattle Snake. Page 191.

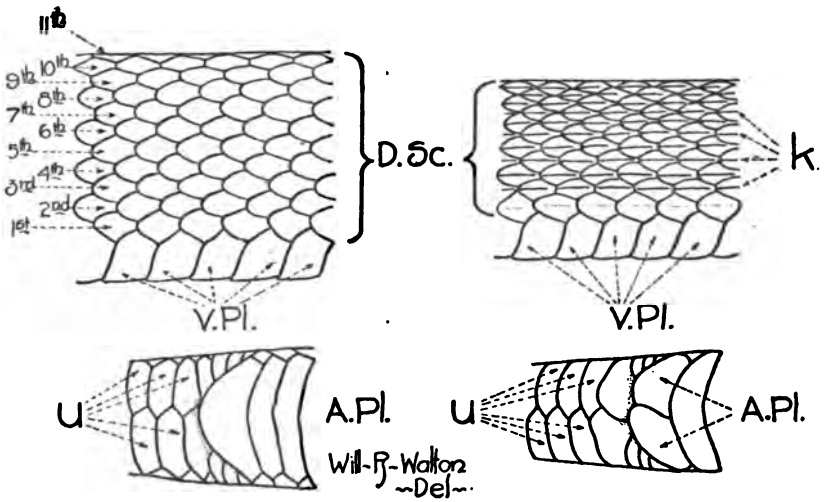


PLATE XIV.—Structural Characters Used in the Classification of Serpents.

A. Pl., Anal Plate (undivided at left, divided at right); D. Sc. Dorsal scales (keeled at right, smooth at left); K. Keels on Scales; U, Urosteges or Tail-plates; V. Pl., Ventral plates or Gastrosteges; 1st, 2nd, 3rd, etc., rows of scale, showing order of counting. Drawn natural size under supervision of the Economic Zoologist.

EXPLANATION OF THE FOOD DIAGRAMS.

The Food Diagrams and Tables in this Bulletin express the results of our dissections of all specimens collected or sent us prior to August 1, 1906, and are, of course, reliable as far as they go. The greatest criticism on them is that we have not been able to study enough specimens to get all the facts of the case for each species. We shall continue these studies from each specimen sent us, and in the Second Report, which will be issued just as soon as we have enough specimens to justify it, there will be new charts and tables showing the newly derived facts.

Each chart or circle represents the total number of serpents containing food, as 100 per cent., and each division of the circle represents the per cent. or relative number of the specimens of the respective species which we found had eaten the food material expressed in that division. Sometimes one serpent contained several articles of food, and most of them contained two or more. These facts had to be considered in making out the charts, and it became quite complex. The bulk or relative amount of food of each kind taken by the reptiles is not shown in these charts, as each division stands for the relative number of this species of serpents examined which contained each food item, respectively.

DISCUSSION BY SPECIES.

No. 1. *Carphophiops amœnus*. (Say.) **Ground Snake. Plates XVI, XXX, Fig. b.**

This rare little snake is known by the various common names of Ground Snake, Red Snake and Worm Snake. It is to be distinguished by the smooth scales on the back (Plate XIV), arranged in thirteen rows, and the ventral plates (Plates XIV and XV), about one hundred and thirty in number, the bifid or divided anal plate (Plates XIV and XV) glossy brown color, small head, absence of constriction on neck, and salmon-red color beneath.

It is found in the United States from Massachusetts to Illinois and southward, although it is not a common species. In this State it must be very rare, because we have before us only one Pennsylvanian specimen, and that was collected in Huntingdon county, Pa., under a stone, by Mr. P. H. Hertzog, July, 1903. Dr. Witmer Stone, in the American Naturalist, Vol. XL, No. 471, Mar., 1906, states that there are specimens of C. Amœnus in the collection of the Academy of Natural Sciences from Chester and York counties, Pa.

There is very little known about its haunts or habits, beyond the fact that it is a burrowing snake and is found in loose soil and under leaves, etc. It is probably one of the egg-laying species, reproducing by laying eggs, and it no doubt feeds during its entire life mostly

upon insects, earthworms, slugs and snails. Dr. D. A. Atkinson has found earthworms in it and says that it also feeds upon insects.

When full grown it is rarely more than a foot long. It is entirely harmless at all times, and is one of the species that is beneficial to mankind, while nothing is known against it from an economic point of view.

No. 2. *Virginia valeriæ.* (B. & G.) **Spotted Ground Snake, or Valeria's Snake.**

It is only upon the printed reports of authors that we include this rare species in the list of Snakes of Pennsylvania. We have neither seen nor collected specimens of it, and we find but one definite record of its collection within the borders of this State, although it has been taken several times in Maryland and Delaware.

Dr. D. A. Atkinson, in his publication on the "Reptiles of Allegheny County," Pa., Annals of the Carnegie Museum, Vol 1, 1901, records taking one specimen at Wilkinsburg, Pa., June 19, 1899, eleven inches in length, and adds: "This is the only record for the occurrence of this snake in Western Pennsylvania." We find no other definite record of it in this State.

It is to be known by its smooth scales (Plate XIV) arranged in fifteen rows, and about one hundred and twenty to one hundred and thirty ventral plates. Its color above is grayish brown with minute black dots often in two rows, and beneath yellowish. It is another of our small snakes, being only twelve inches or less in length, and living in grass, weeds, and brush or under stones or logs. In the United States it is found from Maryland to Illinois and southward, and consequently Pennsylvania is its nothern limit. However, it should be collected in the southwestern and southeastern corners of this State, and we request observers to send us small serpents of all kinds from their regions that we may continue to study these rare species.

It is non-venomous and entirely harmless in every regard, and feeds mostly upon insects, earthworms, slugs and other very small forms of animal life. Mr. Max Morse in a Bulletin on "The Reptiles of Ohio," reports having found "worms and insects" in specimens he examined in Ohio.

We are at present entirely unable to state how, when or where this species reproduces, as these facts are not known to anyone.

No. 3. *Haldea striatula* (L.) **Brown Snake.**

This species, which is rare, if at all found in our State, can be recognized by the keels on the scales (Plate XIV K, and Plate XV 26) and the bifid or divided anal plate (Plate XV 25), the scales

arranged in 17 rows, two loral plates present and the tail one-third of the total length, which is not over twelve inches. The head is long, neck small, eyes large, color reddish-gray above and salmon-red beneath.

While the preceding species is known as a southern serpent, this one occurs in western localities, living from Virginia to Wisconsin and Texas. It should be found in the southern part of Pennsylvania, but we find no record where it has been collected in this State, and we have no specimen of it. We insert it here upon the authority of reliable although earlier writers upon the subject, and hope that our friends who have the good fortune to live in the southern part of this Commonwealth will help to make our search for this species successful. While we have been unable to examine any specimens, and find no author mentioning its food, it no doubt feeds upon insects, earthworms, mollusks and very small frogs and toads. Concerning its manner of reproduction we are unable to find any indications or reports.

No. 4. *Storeria occipitomaculata* (Storer.) **Red-bellied Snake.**

The Red-bellied Snake, of course, receives its name from the color of the under side, which is salmon red. However, this character should not be relied upon too closely, as all specimens of this species do not have such well-marked red colors beneath, and specimens of certain other species, especially the next, and the preceding, are often reddish below. Its generic name, "Storeria," is given it in honor of Dr. David Humphreys Storer, an early and noted writer on Reptiles. The specific name, "occipitomaculata," means "spotted occiput," or top of head, and refers to the three pale blotches which are quite constantly present on the occiput or back of head.

The Red-bellied Snake is described as follows: "Grayish or chestnut brown, usually showing a paler vertebral band bordered by blackish dots; obscure dots on one side; occiput with three pale blotches (a very constant feature); belly salmon red; scales in fifteen rows; ventral plates one hundred and twenty to one hundred and twenty-five; length twelve inches." (Jordan.)

This little snake rarely reaches more than twelve inches in length, and is often not more than three or four inches long. It is, of course, entirely harmless and lives under rocks, in woods, and along fences, throughout the entire State of Pennsylvania. We have received specimens from contributors in the following counties of Pennsylvania:

Bedford County, ...Yont, G. W., ... Osterburg.
Blair County, ...Reddle, (Miss) Bertha, ...Bushman.
Bradford County, ...Wilcox, E. A., ...Sugar Run.

Cambria County,	Brubacker, F. M.,	Johnstown.
Clarion County,	Welch, W. Y.,	Clarion.
	Kauffman, M. M.,	Clarion.
Clearfield County,	Rapp, A. C.,	Kylerstown.
Erie County,	Mixer, E. W.,	Waterford.
	Laurie, C. F.,	Erie.
Indiana County,	Wehrle, R. W.,	Indiana.
Jefferson County,	Luther, Paul,	Pekin.
Lycoming County,	Spencer, Douglas,	Williamsport.
McKean County,		Port Allegany.
Schuylkill County,	Miller, A. B.,	Barnesville.
Sullivan County,	Wieland, W. S.,	Nordmont.
Tioga County,	Nelson, A.,	Canoe Camp.
Warren County,	Whitcomb, Mrs. F.,	Corydon.
	Wright, B. B.,	Sugar Grove.
Wayne County,	Bullock, W. H.,	Honesdale.

This does not mean that it is not found in other counties, as we expect to receive it from all of them in the course of time, but it would indicate a greater abundance in the central and western parts of the State. In the United States it is to be found from Minnesota eastward to Massachusetts, and from those two states southward to Georgia. It is very abundant in portions of its range, and is one of the common small, harmless and in fact beneficial snakes of our State.

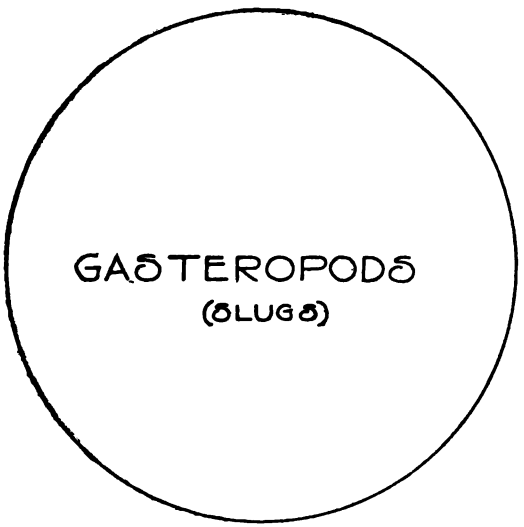


Fig. 4.—Diagram showing the percentage of Food Items of Red-bellied Snake (*Storeria occipitomaculata*): 100 per cent. Slugs.

Although common, it is not often seen. The reason for this is that it is a quiet, retiring little snake, protected by its grayish or

chestnut brown colors, living among leaves and sticks and not observed by most persons, even in localities where it occurs.

Of the specimens of this species which we have received, only five contained food, and this was entirely slugs or shelless snails. It is important to note that in the five stomachs were twelve slugs, which are so very destructive to garden plants, especially cabbage, lettuce, beans, peas and young plants of nearly all kinds, when growing close together in beds. Therefore, in reply to the many inquiries we have received, asking how to get rid of slugs we recommend introducing and preserving this harmless and valuable little snake. It is interesting to know that this is the first and only definite publication upon the food of this species, previous authors not even venturing suggestions upon it.

Owing to the fact that all the food which we have yet found in their stomachs consists of slugs, and these mollusks feed mostly by night rather than by day, we may conclude that the Red-bellied snake is nocturnal in habits, and no doubt it remains concealed during much of the day time and comes forth at night to take as food those creatures which have the habit of crawling and feeding on vegetation by night, and finding concealment in the daytime. Perhaps this species feeds in daytime in places of concealment, as under logs, boards, stones, etc., where slugs may be found hiding by day.

From our anatomical dissections of this serpent, we find nothing significant concerning its manner of reproduction. The other species of this genus is ovoviviparous, hence we believe this species reproduces in the same manner. No available literary reference contains any statement on this point. If we could receive enough specimens during July and August, it would soon be settled.

The largest specimen we have received was No. 3117, from Jefferson county, which was fourteen inches long, and showed the singular variation of having the belly blue-black instead of salmon-red, in accordance with most individuals of this species. The smallest specimen we have received was six inches in length, which is our No. 4131 a, from Port Allegany, McKean county, Pa.

No. 5. *Storeria dekayi* (Holb.). DeKay's Snake or Rock Snake. Plate XVII.

DeKay's snake must be very similar to the Red-bellied Snake, since it belongs to the same genus: *Storeria*. It consequently agrees with No. 4 in having keels on the dorsal scales and a bifid anal plate, the tail not one-third of the entire length, the loral plate absent, and the color brownish; but it has seventeen rows of scales instead of fifteen, as in No. 4, and generally has a gray dorsal band bordered by lines of dots, and is grayish below instead of

salmon-red. Thus, in general, it should not be difficult to distinguish each of these two species of the same genus.

This small serpent, which is about a foot long, is found in the Eastern United States, westward to the Rocky mountains, and is not especially rare in this State, although it is not often seen. We have received specimens from the following counties: Bucks, Dauphin, Erie, Huntingdon, Luzerne, Monroe, Montour, Northampton and Venango. A comparison of this with the former species shows a tendency toward its eastward rather than westward distribution. It lives among brush and stones and is protected by its coloration.

Comparatively little is known of its habits, although it is not one of the egg-laying species, but is ovoviviparous, as our dissections show with certainty. From the specimens examined, we are sure in saying that it bears its young from the latter part of July to the last of August. It is no doubt mostly nocturnal in its habits, finding concealment during the day beneath rocks and stones, and coming forth at night for food.

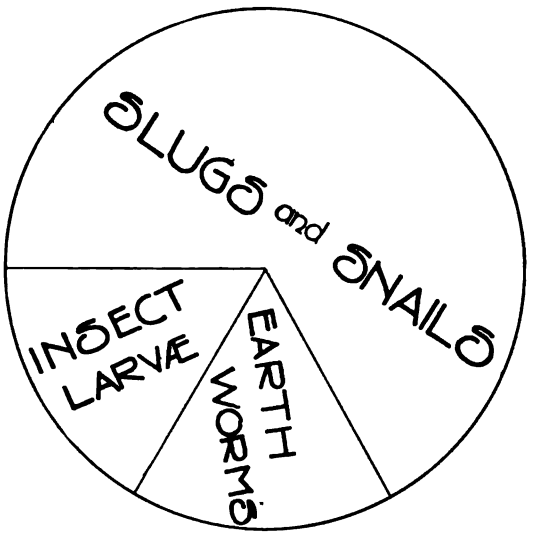


Fig. 5.—Diagram showing the percentages of Food Items of Rock Snake (*Storeria dekayi*): 67 per cent. Slugs and Snails; 16 per cent. Insect Larvæ; 17 per cent. Earth Worms.

Of the twenty-one specimens which we have examined, only four contained food. This material was found to consist of earthworms, slugs, snails and insect larvæ. The details are as follows: Earthworms in one; slugs in three; undetermined snails in two; and undeterminable insect larvæ in two. This shows that these little serpents

are beneficial rather than obnoxious. They are not poisonous, and in every way should be protected.

Holbrook, in 1842, published that it ate "insects, grasshoppers and crickets," and a few other writers have followed him, but this was only a supposition. We can find no other published notes on the food of this harmless and beneficial little serpent.

The summary of our collection of this species in Pennsylvania is as follows:

Bucks County,	Kreiss, P. S.,	Benjamin.
Clinton County,	Singer G. P.,	Lock Haven.
Dauphin County,	Stevenson, A.,	Harrisburg.
	Wise, Norman,	Harrisburg.
	Anderson, C. S,	Harrisburg.
	Fickes, Howard,	Harrisburg.
Erie County,	Laurie, C. F.,	Erie.
	Mixer, E. M.,	Waterford.
Huntingdon County,	Payne, W. S.,	Orbisonia.
Lycoming County,	Van Housen, Chas.,	Williamsport.
Luzerne County,	Campbell, E. W.,	Pittston.
Monroe County,	Schock, H. M.,	Effort.
Montour County,	Dieffenbacher, D. N.,	Danville.
Northampton County,	Rice, A. J.,	Easton.
	Mack, J. A.,	Bethlehem.
Venango County,	Blatt, W. O.,	Oil City.
Washington County,	Couch, Merle,	Hickory.

No. 6. *Olonophis kirtlandi* (Kenn.) **Little Red Snake.**

The Little Red Snake is a western species, being found mostly from Ohio to Illinois. We have received only one specimen of this species from Pennsylvania. It is our No. 1411, sent by Mr. L. Christie, of West Sunbury, Butler county, September 28, 1904. As the stomach was empty nothing can be said about its food, and the only published statement we can find is by Dr. Atkinson, who merely says that in captivity it ate slugs. It is to be sought and no doubt found in the western and especially the southwestern parts of Pennsylvania, and we hope that interested persons in that part of the State will watch for it and send us specimens.

The Little Red Snake is to be distinguished from all others by the fact that all the scales are keeled and arranged in nineteen rows, and the anal plate is bifid or parted. The ventral plates are about one hundred and thirty-five in number, and the head is small, black and shining. The color above is light reddish brown with four series of round black spots, and the belly is reddish with a row of black spots on each side. This coloration will distinguish it, as other species do not have the spots. Comparatively little is known of its habits or food. Our specimen is fifteen inches in

length and contained six embryos, one of which was measured and found to be four and one-half inches long. Thus, it is proven to be ovoviviparous. It doubtless feeds upon insects, earthworms, mollusks, etc., as do the species previously discussed in this Bulletin. The average length is about sixteen inches, and it is non-venomous and entirely harmless in every regard.

We shall make a special effort to reciprocate favors with persons who send us specimens of this and other of these rare reptiles, and invite naturalists to send us notes upon their occurrence, and particularly to give us information of dates and places of capture and collections in which they are now to be found. These facts are to be recorded in full in our next Report upon this subject.

No. 7. *Thamnophis saurita* (L.) The Ribbon Snake. Plate XVIII.

The Ribbon Snake, or the Striped Garter Snake belongs to the genus *Thamnophis*, the same as the other Garter Snakes. This genus is characterized by all species having the dorsal scales more or less keeled, the anal plate entire or not divided, the scales arranged in nineteen to twenty-one rows, the ventral plates about one hundred and fifty-five in number, and the coloration mostly arranged in stripes. There is only one pair of frontal plates and two nasals, and although the posterior teeth are rather large, this is for the purpose of holding their prey rather than for injecting poison. The snakes of this genus or The Garter Snakes, are all non-venomous or harmless species and are also ovoviviparous, or bearing living young.

This species, which is designated by the common name Ribbon Snake or Swift Garter Snake, is distinguished from the other Common or Garter Snake (T. *sirtalis*) found in this State by having the lateral stripe on the third and fourth rows of scales, rather than on the second and third, as in No. 8, and also by the scales being little or not spotted; a plain dorsal band present, stripes all alike in color, and the body very slender. This snake is a dirty chocolate color, with three yellow stripes and light brown color below the lateral or side stripes. The entire body is about three and one eighth times the length of the tail. The colors are bright and striking in appearance, and the length is from two to three feet.

The Ribbon Snake or Swift Garter Snake is ovoviviparous, or produces living young, and according to the evidences which we have they are born during the month of August. It is one of the species that is known to swallow their young for protection and then as quickly as possible run to a place of safety and permit them to escape.

The following are our Pennsylvanian contributors of this species:

Beaver County,	Fennell, Thos.,	Cannelton.
Berks County,	Becker, W. D.,	Fleetwood.
Blair County,	Bohn, Dr. D.,	Altoona.
Erie County,	Mixer, E. M.,	Union City.
Lebanon County,	Bohn, J. G.,	Onset.
Luzerne County,	Campbell, E. W.,	Pittston.
Tioga County,	King, L. K.,	Westfield.
Wayne County,	Bullock, W. H.,	Honesdale.
Wyoming County,	Kerney, F. B.,	Laceyville.

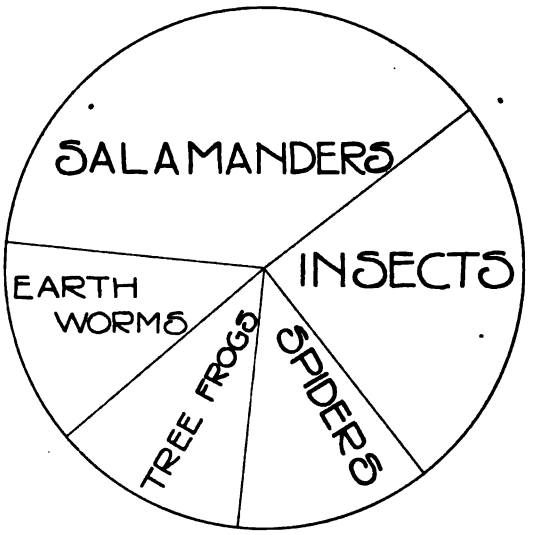


Fig. 6.—Diagram showing the percentages of Food Items of Ribbon Snake (*Thamnophis sauritus*): 37½ per cent. Salamanders; 25 per cent. Insects; 12½ per cent. Spiders; 12½ per cent. Earth Worms; 12½ per cent. Tree Toads.

This species belongs to the Eastern United States, being found mostly east of the Alleghenies, especially near streams. It likes to live in rocky woodlands, in shady, narrow, watered valleys and to plunge into water when frightened. It is not poisonous nor venomous, and in its feeding habits it preys mostly upon beneficial Batrachians, and is consequently objectionable because these animals are the enemies of obnoxious insects. In our dissections only four were found containing food and the analysis of their stomach contents is as follows: One specimen contained earthworms only; one contained a salamander, a tree frog, and fragments of insects and spiders; one contained a salamander and insects, and the fourth contained two salamanders, and insects. Beyond any reasonable doubt all the insects and spiders in the stomachs of these serpents came from the batrachians which had eaten them previously to the time of the snake making its meal upon the devourer of insects.

A detailed table of the food contents of these serpents is as follows:

No. of Snakes Eating:	Kind of Food Material:
1	Earth worms.
1	Spiders.
1	Undet. Insect fragments.
2	Insect fragments with salamander remains.
1	Insect fragments with frog remains.
2	Undet. Beetles.
2	Black Ants.
1	Red Ants.
1	Undet. Salamander.
2	Plethodon cinereus (Salamander).
1	Spelerpes bellneatus (Salamander).
1	Hyla versicolor (Tree Frog).

Formerly published statements report this serpent as feeding upon the following material:

Toads (De Kay, in N. Y. Geological Report, and Morse, in Ohio Bulletin), Frogs (De Kay), Insects (De Kay and Morse), Worms (Morse).

There is no evidence that those or other authors actually observed this reptile eating these creatures. The only report of positively observed food that we have found was recorded by Dr. Atkinson who published that he has found tadpoles, beetles and crickets in their stomachs.

From the study of our tables it can be seen that the chief food of those we have examined is the salamanders, and this is something that has not been mentioned before by anyone in connection with this species. It is also apparent that the insects mentioned above, as well as those observed by others, may have been taken originally with the batrachians which had previously captured them.

No. 8. *Thamnophis sirtalis* (L.) **Common Garter Snake. Plate XXII.**

Owing to the fact that there are several varieties of this species of snake and these varieties are distinguished more by the variations in color than in any other way, it is variously known as the Striped Snake, Spotted Garter Snake, Blue Spotted Snake, and other common names besides that of the Garter Snake and Common Garter Snake and Lond Schlong (Pennsylvania German). As it belongs to the same genus as the preceding, the distinguishing generic characters are the same as those there given. However, it differs from No. 7, the Ribbon Snake, in having the lateral or side stripes, when present, on the second and third rows of scales (from below) instead of on the third and fourth, and also in having a heavier or stouter body, the tail about one-fourth the total length,

and the stripes often obscure. The general color is olive, with a narrow dorsal stripe and three series of small dark spots on each side, about seventy being found between the head and base of tail.

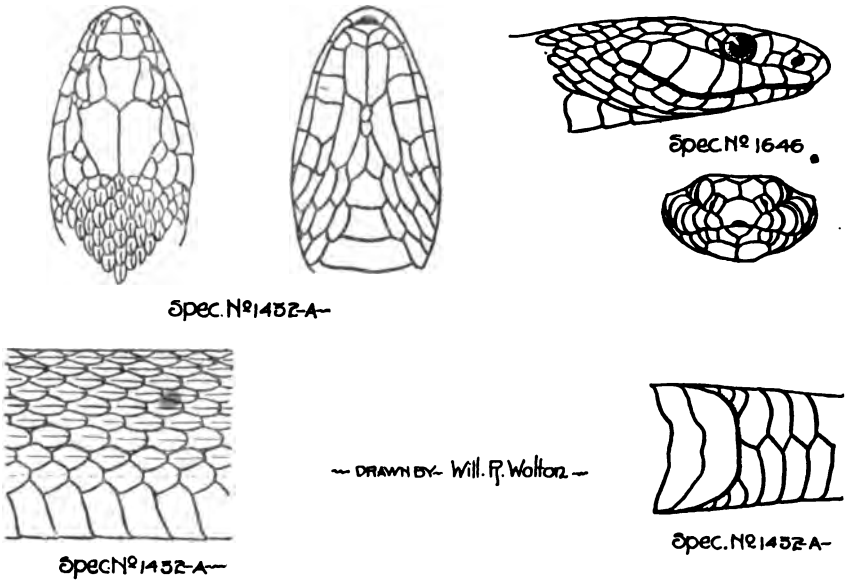


Fig. 7. Structures of Garter Snake (*Thamnophis sirtalis*). Natural Size. Drawn under the Supervision of the Economic Zoologist.

The sides and belly are greenish, and the side stripes are rather broad and often almost entirely obliterated or broken into small spots. The colors are much duller than in the preceding species.

The Garter Snake is by far our most common snake, and is found almost everywhere in the United States except in California. It is found everywhere in Pennsylvania, and commonly occurs near the abode of man. This has earned for it the occasional name of "Garden Snake." This seems to be a reptile which has not yet settled down to a fixed type of coloration, as there are at least three or four prominent varieties in this State and these are distinguished by additional varietal names, *Thamnophis sirtalis ordinatus*, or the Ordinary Spotted Garter Snake, shown in Plate XX, has the stripes obscure or wanting, and the spots distinct; also spots are present on the sides of the ventral plates. It is northeastern variety. *Thamnophis sirtalis dorsalis* (Baird and Girard), shown in Plate XIX, or the Spotted and Striped Garter Snake, has the dorsal stripe broad and two rows of distinct spots on each side of it. This is a common North American species and is found abundantly in this State.

Another variety which is given the scientific name *Thamnophis*

PLATE XIX.—Garter Snake, variety Spotted and Striped. (*Thamnophis sirtalis dorsalis*).

Photographed alive and in Natural Surroundings, by Mr. Wm. H. Fisher.

PLATE XX.—Garter Snake, Spotted Variety (*Thamnophis sirtalis ordinatus*).
Photographed in Nature by Mr. Wm. H. Fisher.

PLATE XXI.—Striped Garter Snake (*Thamnophis striatis parietalis*).
Photographed in Nature by Mr. Wm. H. Fisher.

PLATE XXII.—Garter Snake (*Thamnophis sirtalis*) Swallowing Toad.
Photographed one-third Natural Size in the Office of the State Zoologist of Pa.

PLATE XXIII.—Queen Snake or Striped Water Snake (*Regina leberis*).
Photographed in Nature by Mr. Wm. H. Fisher.

PLATE XXIV.—Spotted Water Snake (*Natrix sipedon*).
Photographed alive and in Natural Surroundings by Mr. Wm. H. Fisher, Baltimore.

PLATE XXV.—Young Pilot Snake (*Callopeltis obsoletus*), and Egg from which it has just hatched. Three-fourths natural size.

Hatched and photographed alive in the office of the State Zoologist of Pa.

PLATE XXVI.—Green Snake (*Opheodrys æstivus*).
Photographed Alive and in Natural Surroundings by Mr. Wm. H. Fisher.

sirtalis parietalis (Say), is known as the Green-striped variety of Garter Snake (See Plate XXI), because the stripes are dull greenish and the space between the spots on the side is brick red in color. This is a very beautiful Garter Snake and is a western variety, being found mostly from Indiana westward.

The Garter Snakes are all entirely harmless, having no poison nor poison glands, and being unable to inflict any injury whatever upon mankind. The stories that are sometimes told about their attempting to choke persons are entirely without foundation, and there is no reason why superstition and ignorance should combine to crush out the life of this animal. It is partly nocturnal in its habits, although it can often be seen sunning itself during the day. It invariably retreats in the most quiet manner when disturbed by mankind, and attempts to conceal itself in holes or beneath stones or logs.

All Garter Snakes are ovoviviparous, bringing forth living young. The eggs of the Garter Snake begin to develop in May and when one-half inch in length they show the spiral of the embryo. These continue to develop until they reach a length of six inches, when the yolk is absorbed and the snakes are born. The young of the Garter Snakes are born between the 25th of July and the 25th of August. This is shown by our specimens No. 1073 (d), No. 3062 (c), No. 3127, and No. 7127 (a). The old snake lives near the young and guards them during the fall. They pass the winter in rubbish, in the earth, beneath stones, or in hollow logs, and in the spring the young shift for themselves.

The many stories that are told concerning these and similar serpents swallowing their young for protection must have truth as their basis, but by the most careful efforts we have up to the present time been unable to find any evidence of this excepting from the reports of other persons. In over two hundred specimens which we have examined and dissected we have never yet found any young in the stomach of the parent, although we have often found the unborn young in ovaries. If any person be able to kill and send us a specimen which has been seen swallowing its young, we shall reward him well for his trouble. We wish them sent dead, but with the young in the stomach just as they were swallowed at the time the observation was made and the parent killed.

We have received the following specimens from the following counties in the State, but desire others of this and other species for continuing our studies:

Allegheny County, ...	Davison, Dodds, ...	Union Station.
	Johnston, Stewart, ...	Pittsburg.
	Cruikshank, O. T. (Dr.), ...	Swissvale.
	The Borroughs Club of Amer.,	Wilkinsburg.

Beaver County,	Wright, F. R.,	Smith's Ferry.
	Dawson, H. D.,	Smith's Ferry.
Bedford County,	Hunter, W. H.,	Bedford.
	Walls, R. B.,	Saxton.
Berks County,	Seidel, J. J.,	Shoemakersville.
	Neithamer, E. F.,	Reading.
	Becker, W. D.,	Fleetwood.
Blair County,	Harvey, W. C.,	Altoona.
Bradford County,	Wilcox, E A.,	Sugar Run.
Bucks County,	Tomlinson, F.,	Eden.
	Franklin, Titus,	Wismer.
	Bewley, Anna K.,	Forest Grove.
	Harstine, D. L.,	Ferndale.
Cameron County,	Blinzler, E.,	Emporium.
Carbon County,	Gallagher, E. L.,	Lansford.
	Solt, N. E.,	Weissport.
	Murphy, J. H.,	Summithill.
Centre County,	Williams, G. W. R.,	Lemont.
	Thompson, J. H.,	State College.
Chester County,	Paxson, O. S.,	Devon.
	Brill, J. G.,	Berwyn.
	Robinson, (Miss) Mona,	Paoli.
Clarion County,	Arnold, F. M., Jr.,	Clarion.
Clearfield County,	Hurd, W. E.,	La Jose.
	Rapp, A. C.,	Kylerstown.
Clinton County,	Laudenslager, D. M.,	Mackeyville.
	White, A. P.,	Lock Haven.
Columbia County,	Creasy, H. B.,	Catawissa.
	Stahl, Harrison R.,	Lightstreet.
	Beam, W. G.,	Catawissa, R. No. 3.
	Klingman, E.,	Beaver Valley.
Crawford County,	Hanks, A. J.,	Cochranton.
	Gilmore, L. B.,	Saegerstown.
Cumberland County,	Cressler, G. E.,	Shippensburg.
	Hull, R. J.,	Lisburn.
	McKinley, H. J.,	Kerrsville.
Dauphin County,	Barrington, H.,	Harrisburg.
	Rouf, F.,	Hummelstown.
	Phelps, S. A.,	Harrisburg.
	Rutherford, A.,	Harrisburg.
Delaware County,	Peddrick, W. E.,	Bellevue.
	Pennell, F. W.,	Wawa.
	Pearson, L. S.,	Wayne.
	Redfield, A. C.,	Wayne.
Erie County,	Mixer, E. W.,	Erie.
Franklin County,	Branthaver, G. M.,	Chambersburg.
	Delong & Atkinson,	Mont Alto.
Fulton County,	Palmer, A. C.,	Warfordsburg.
Huntingdon County,	Gibbs, E. E. C.,	Huntingdon.
	Swoope, I. P.,	Huntingdon.
Indiana County,	Palmer, L. D.,	Black Lick Station.
	Likert, H. W.,	Black Lick Station.
	Wehrle, R. W.,	Indiana
Jefferson County,	Brian, Chas.,	Brockwayville.

Lackawanna County,	Winship, Lionel,	Moscow.
Lancaster County,	Miller, E. G.,	Columbia.
	Kautz, E. M.,	Lancaster.
Lawrence County,	Hawthorne, L. H.,	New Castle.
Lebanon County,	Mell, J., Jr.,	Richland
	Bohn, J. G.,	Onset.
	Boeshore, Alfred,	Jonestown.
	Bean, W. J.,	Bunkerhill.
	Hain, H. G.,	Lebanon.
	Strauss, C.,	Fredericksburg.
Luzerne County,	Shuman, E. F.,	Glen Lyon.
	Angus, W.,	Stoddartsville.
	Campbell, E. W.,	Pittston.
Lycoming County,	Mulford, E. R.,	Okome.
	Ulmer, R. D.,	Cogan Station.
	Van Housen, Bruce,	Williamsport.
Monroe County,	Allegar, I. L.,	Shawnee.
	Carey, T. H.,	Cresco.
	Blakeslee, J. A.,	Blakeslee.
Montgomery County,	Harley, R. E.,	Pottstown.
	Kelm, W. P.,	Pottstown.
	Haines, M. M.,	Cheltenham.
	Kratz, E.,	North Wales.
	North, G. W.,	Prospectville.
Northampton County,	Green, J. W.,	Easton.
	Bedford, G. H.,	Nazareth.
	Reitz, Rev. J. J.,	Walnutport.
Northumberland County,	Leitzell, C. W.,	Northumberland.
	Leitzell, E. A.,	Northumberland.
Perry County,	Brightbill, H. A.,	Marsh Run.
	Brightbill, Mrs. M.,	Marsh Run.
	Brightbill, H. A., Jr.,	Marsh Run.
	Kugler, J. W.,	Duncannon.
Philadelphia County,	Bernicker, I. L.,	Philadelphia.
	Simon, E.,	Philadelphia.
Potter County,	Kidney, M. F.,	Raymond.
Snyder County,	Snyder, E. W.,	Selingsgrove.
	Bordner, H. H.,	Shamokin Dam.
	Bingman, E.,	Beavertown.
	Apple, P. A.,	Middleburg.
Somerset County,	Suhrie, J. E.,	Crumb.
Sullivan County,	Wieland, W. S.,	Nordmont.
Susquehanna County,	Clough, J. H.,	Montrose.
	Gere, C. E.,	Brooklyn.
Tioga County,	Barnes, O. J.,	Mansfield.
	Andrews, S. F.,	Wellsboro.
	King, L. K.,	Westfield.
	Cook, Wright,	Austinburg.
	Nelson, A.,	Canoe Camp.
Venango County,		Oil City.
Washington County,	Couch, Merle,	Canonsburg.
	Couch, Jos.,	Canonsburg.
Wayne County,	Bullock, W. H.,	Honesdale.
Westmoreland County,	Schell, J. M. B.,	Jeanette.

Wyoming County, ...	Gardner, T. L., ...	Meshoppen.
	Kerney, F. B., ...	Laceyville.
York County, ...	Gable, J. G., ...	Stewartstown.
	Baker, B. W., ...	Turnpike.
	Leber, Chas., ...	Wrightsville.
	Johnson, J. Q., ...	Slab.

In literature the food of the Garter Snake is reported as follows: Toads (Holbrook, De Kay and Morse), Frogs (De Kay), Tadpoles (Garman in Ill. Bulletin), Small Quadrupeds (De Kay), Small Reptiles (Holbrook), Fish (Garman), Insects (Morse and Garman), Worms (Garman), and Mice, Shrews, young Birds and Eggs (New International Encyclopedia).

None of these authors states definitely that he has observed such food of the Garter Snake, but Dr. Atkinson says he found that its food consists of batrachians, chiefly the common toad.

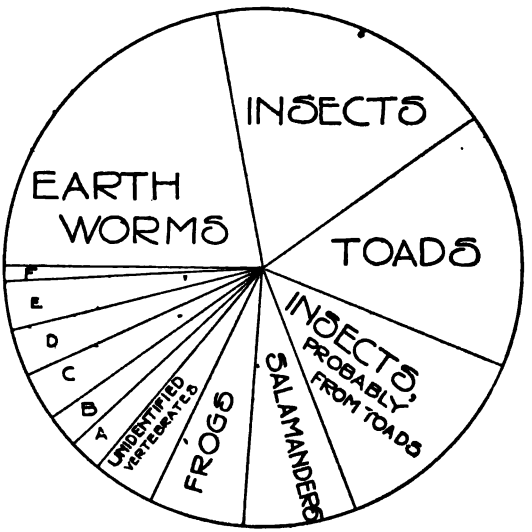


Fig. 8.—Diagram showing the percentages of Food Items of Garter Snake (*Thamnophis sirtalis*): 22 per cent. Earthworms; 18 per cent. Insects; 16 per cent. Toads; 13 per cent. Insects from Toads; 7 per cent. Salamanders; 6 per cent. Frogs; 4 per cent. Unidentified Vertebrates; 2 per cent. Snails; 2 per cent. Insects, Probably from Frogs; 3 per cent. Tree Toads; 3 per cent. Unidentified Batrachians; 3 per cent. Probably Toad; 1 per cent. Probably Sparrow.

The following is a tabulation of the food materials found in the study of the Garter Snake:

No. Specimens:	Food Materials:
1	Undet. worm.
22	Earth worms.
1	Stenotrema (Snail).
2	Undet. Snails.

No. Specimens:	Food Materials:
1	Spider.
1	Millipede.
8	Undet. Insect fragments.
7	Insects with toad remains.
7	Insects with toad remains (probably).
2	Undet. Species Orthoptora.
2	Acrididæ.
1	Locustidæ.
1	Common Cricket.
1	Undet. Lepidoptera.
2	Undet. Larvæ (Diptera).
7	Undet. Beetles.
3	Undet. Ground Beetles.
1	Calosoma scrutator (The Searcher).
1	Black Ground Beetle (Harpalus).
1	Rove Beetle.
1	Lady Bird.
2	Fire Flies.
1	Scarabaeidæ.
1	Bumble Flower-Beetle.
3	Col. Potato Beetles.
2	Weevil or Snout Beetles.
1	Undet. sp. Hymenoptera.
4	Black Ants.
1	Red Ants.
5	Undet. Vertebrates.
1	Undet. Batrachian.
1	Plethodon cinereus (Salamander).
4	Plethodon glutinosus (Salamander).
17	Common Toad.
2	Pickering Tree Frog.
1	Undet. Frog.
2	Leopard Frog.
2	Woods Frog.
1	Green Frog.
1	Sparrow.
5	Undet. Mammals.

It will be seen that these reptiles fed to a great extent on earthworms, and a great many contained insects or fragments of insects. However it must be acknowledged that a great many of these insects were taken inside of the toads and other batrachians which the Garter Snake had eaten. While there is quite a list of insects in the above table the Garter Snake must be regarded as one of the chief enemies of the toad, and this animal is one of the most important insectivorous creatures on the premises. Thus the economic value of the Garter Snake is decidedly questionable. It is our opinion that the destructive insects which are eaten independently by this reptile do not counterbalance the harm done in destroying the toads and salamanders. It is true that in the above list we

find such objectionable creatures as snails, grasshoppers, locusts, crickets and larvæ of moth, besides potato beetles, weevils, and ants. On the other hand, among the beneficial creatures must be recognized the earthworms, spiders, ground beetles, rove beetles, lady birds, salamanders, toads, tree frogs and frogs. We found no evidence of fish in any of the entire number studied.

No. 9. *Regina rigida* (Say). **Rigid Queen Snake.**

There are two species of the genus Regina or Queen Snakes found in the State of Pennsylvania, although both are rare. They are to be distinguished by the keels on all of the dorsal scales, the bifid or two-parted anal plate, scales arranged in nineteen rows, ventral plates about one hundred and fifty, striped colors, and haunts near water. They are ovoviviparous, bearing young.

The common name, "Rigid Queen Snake," is but a translation of the scientific name of the genus and species, *Regina rigida* and is given as the common name of this snake because no other has been suggested and none is in general use either by writers or by country people. This species may be called the Brown-banded Leather Snake from the two brown dorsal bands. It is greenish brown in general color. Besides the bands along the back, it has a brown spot on each scale on the sides, causing the sides to present a speckled appearance; the belly is yellowish and blotched with darker, and the outer or lower row of scales is smooth. This snake reaches a length of about twenty-four inches and is harmless and probably beneficial in feeding habits. Nothing is published nor known with certainty concerning the details of its habits or food. It is inserted in this list upon the published authority of Dr. O. P. Hay. The Rigid Queen Snake is found from Pennsylvania to Georgia, chiefly south of the mountains and westward to central Illinois. This makes it more of a southern species than most of those found in our State. As Pennsylvania is its northern limit we see why it is rare in this State. It is to be expected where the Carolinian fauna extends into the southeastern and southwestern corners of this State, and possibly along the entire southern border. Persons in those regions are requested to give us special aid in our efforts to learn and disseminate some information about it.

No. 10. *Regina leberis* (L.) **Queen Snake or Striped Water Snake. Plate XXIII.**

This is a common water snake which generally is not distinguished by any common name in this State. In his published statement in 1882 in "The Reptiles of Ohio," W. H. Smith refers to this species as the Yellow-bellied Snake or Leather Snake. Doubtless

the reason for ignoring its distinction is that many persons regard this as the Common Water Snake. It is distinguished from Garter Snakes by the anal plate, which is bifid or parted in this species and entire in the Garter Snakes. It also lacks the spots often seen on Garter Snakes. It differs slightly from the Water Snake (No. 11) in its general smaller size and the absence of spots.

The Striped Water Snake is dirty chestnut in color, with a yellow band along the lower part of each side, which becomes a narrow stripe along the neck, with a yellow spot on the base of each upper jaw. There are three narrow dorsal stripes, often inconspicuous, and the head is small and dark in color above the middle of the eye. The belly is yellow with two broad bands, but without the reddish spots, as seen in the Water Snake. The true scales are all keeled and are arranged in nineteen rows. The average length of this snake when full grown is twenty-four inches, although younger specimens, smaller in size, are often seen.

The Queen Snake or Striped Water Snake is another species that is ovoviviparous, or bears young. In this State it reproduces during the month of September, and brings forth from 6 to 12 young, which it remains near, according to the manner of the Garter Snake.

This species is much more common in this State than the preceding. We have received nineteen specimens from the following counties listed in our records:

Allegheny County,	Couch, Witmer,	Carnegie.
Berks County,	Witman, May,	Reading.
Dauphin county,	Sober, Miss Martha G.,	Dauphin.
Fayette County,	Lange, W. H.,	Belle Vernon.
Lancaster County,	Wistar, J. J.,	Columbia.
Lebanon County,	Bohn, J. G.,	Onset.
Montgomery Countty,	Benner, Raymond,	Telford.
	Benner, W. M.,	Telford.
Washington County,	Couch, Jos.,	Hickory.
	Couch, Merle,	Canonsburg.

This table shows that it is well scattered over the State, and it is probable that proper search would reveal it in all the counties. It is found throughout the United States and Canada, and appears to be perfectly at home in and under water.

The literature at hand does not contain any references whatever of the probable food of this species, but Dr. Atkinson says he found in their stomachs crayfish, fish and small frogs.

Of the fifteen specimens which we have examined, four contained crayfish, and one contained a toad. Judging only from these known facts of its feeding habits, it would not be considered beneficial to mankind from an economic standpoint, because it destroys

creatures that are desirable, such as the crayfish and fish, which are utilized by mankind or are food for larger fishes. The crayfish is also beneficial from an economic standpoint, as it is an

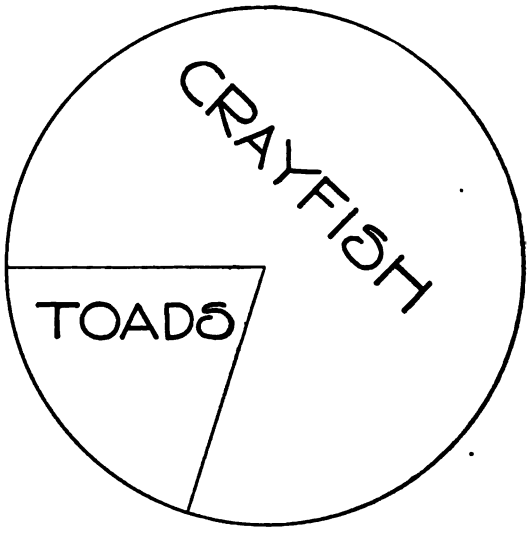


Fig. 9.—Diagram showing the percentages of Food Items of Striped Water Snake (*Regina leberis*): 80 per cent. Crayfish; 20 per cent. Toads.

important element in the food of bass, eels, and other fishes; and toads and frogs are among our most valuable insectivorous creatures. However, the Queen Snake is entirely non-venomous and as it is an interesting and beautiful form of animal life and is rather rare in this State, we do not find sufficient justification to sanction any attempt at its extermination.

No. 11. *Natrix sipedon*. Water Snake. Plate XXIV.

This is the most common Water Snake, and is consequently known as "The Water Snake," or "Wasser Schlange," in Pennsylvania German. It is sometimes called The Brown Water Snake, although this common name would as well apply to the preceding species. It is also sometimes called the Moccasin, but this name is misleading and should never be given to any species of snake found in Pennsylvania. The true Water Moccasin is a southern species of snake, not occurring north of Virginia, and it is an exceedingly poisonous or venomous species, as it belongs to the same genus as the Copperhead. Although our Common Water Snake has a violent temper when angered, and strikes viciously at its captor, it is not poisonous in the least. It has sharp teeth, which are used in holding its prey, and these may cause bleeding, but need not be the source of any alarm. We know personally

whereof we write in this regard, as we have been bitten by this snake until the blood flowed and no more pain was felt than would be experienced by scratching with a very sharp needle.

The Common Water Snake is to be distinguished by the keels on all scales and the number of rows, which is twenty-three. They have about one hundred and sixty ventral plates, with large reddish or brownish spots on the under side, and the anal plate bifid. Strange to say, this harmless snake is often mistaken for the Copperhead and sent to us for that very poisonous species, but it has no fangs nor venom and in fact does not belong to the same family as the Copperhead or Rattle Snake. It is to be distinguished by its long slender tail, and especially by its lack of the pit between the eyes and nostrils, which is found only in venomous serpents, and also by the divided urosteges or plates beneath the tail (Plate XIV and XV), which in the venomous reptiles are not divided (Figs. 20 and 22).

The general color of the Water Snake is brownish, with a dorsal row of large square dark blotches and a row of smaller blotches on each side, which are so arranged that they alternate with the dorsal blotches. However, these blotches may at times be almost obliterated, and it is then nearly a uniform brown above. The under side is blotched with triangular reddish-brown blotches on a background which is generally pale yellow. The adult reaches from thirty to fifty inches in length, and of course, younger specimens are shorter.

The Water Snake is found abundantly along streams from New England to Kansas and southward and is one of the most common serpents in this State. We have received specimens from thirty-three counties of this State and do not doubt its existence in considerable numbers in all the other counties. Our present records are as follows:

Adams County,	Miller, P. E.,	Heidlersburg.
	Hoffnagel, H.,	New Oxford.
	Osborn, C. L.,	Aspers.
	Michner, Anna and Ray,	Aspers.
Allegheny County,	Couch, Witmer,	Carnegie.
Berks County,	Sauler, Mary,	W. Leesport.
	Sherman, J. M.,	W. Leesport.
	Neithamer, F.,	Reading.
	Whitman, Mary,	Reading.
	Fritz, Mary E.,	Boyertown.
	Grim, W. H.,	Hamburg.
Bucks County,	McGarvey, R.,	Richboro.
	Oppenlander, Dorothea,	Paseer.
	Atkinson, J. W.,	Buckingham.
	Bewley, Anna K.,	Newton.
Cameron County,	Blinzler, E.,	Emporium.

Carbon County,	Salt, N. E.,	Weissport.
Chester County,	Lawrence, Jno.,	Coatesville.
	Baldwin, O. H.,	Parkesburg.
Crawford County,	Morris, C. L.,	Mosiertown.
Cumberland County,	Robbins, Jesse,	Carlisle.
Dauphin County,	Sober, Miss Martha G.,	Dauphin.
	Ruof, F.,	Hummelstown.
	Weast, W. W.,	Stony Creek.
	Lauffer, M.,	Middletown.
Delaware County,	Robertson, A.,	Sharon Hill.
	Pearson, L. S.,	Wayne.
	Satterthwaite, O.,	Wawa.
Erie County,	Seldon, F. H.,	Cranesville.
	Mixer, E. W.,	Erie.
Fayette County,	Lange, W. H.,	Belle Vernon.
	Lyons, W. T.,	Cheat Haven.
Franklin County,	De Long, C. A.,	Mont Alto.
	Hopkins, E. D.,	Mercersburg.
Fulton County,	Palmer, A. C.,	Warfordsburg.
	Jackson, Robt.,	McConnellsburg.
Huntingdon County,	Black, Joel,	Huntingdon.
	Gibbs, E. E. C.,	Huntingdon.
	Ballinger, J. L.,	Huntingdon.
Lancaster County,	Heiserman, J. J.,	Lititz.
Lebanon County,	Baeshore, A.,	Jonestown.
	Bohn, J. G.,	Onset.
	Mell, J., Jr.,	Richland.
	Derickson, S. H.,	Annville.
Lehigh County,	Dickenshied, F. S.,	Zionsville.
Luzerne County,	Angus, Wm.,	Stoddartsville.
Lycoming County,	Rothrock, B. P.,	Williamsport.
	Spencer, R. D.,	Williamsport.
Monroe County,	Allegar, I. L.,	Shawnee.
	Coggler, B. G.,	Tobyhanna.
Montgomery County,	Behner, W. M.,	Telford.
Montour County,	West, Mrs. G. P.,	Danville.
Perry County,	Brightbill, H. A.,	Marsh Run.
	Hooke, B. P., Jr.,	Landisburg.
	Showalter, C. E.,	Landisburg.
	Bowers, M. R.,	Landisburg.
	Shumaker, A. J.,	Blain.
Philadelphia County,	Blake, J. F.,	Fox Chase.
Schuylkill County,	Schwaler, E.,	Valley View.
Susquehanna County,	Brown, N. S.,	Springville.
Tioga County,	Mulford, E. R.,	Wellsboro.
Venango County,	Bean, Lavella,	Emlenton.
Warren County,	Weld, R. W.,	Sugar Grove.
Wayne County,	Bullock, W. H.,	Honesdale.
York County,	Frey, G. T.,	Emigsville.

The Water Snake is to be seen singly or in numbers, basking in the sunshine on brush or bushes over water into which it plunges and finds concealment when disturbed. It takes its food both under water and out, and both pursues it and lies in wait for

it. We have more than once observed the sagacity of this serpent as it captured a catfish or some other fish and carrying it out of the water to the rocks on the shore, where the fish was helpless and more easily devoured. We saw one very small specimen of Water Snake on the shore of Cayuga Lake, Ithaca, N. Y., which was vainly trying to swallow a wriggling catfish, *Ameiurus nebulosus*, or Bullhead, which was several times its own diameter, but which it had captured by seizing the lower jaw in its mouth and had taken from the water to the rocky shore a few feet away.

In literature we find the food of Water Snakes reported as follows: Frogs (Harlan, Holbrook and De Kay), toads (Holbrook and Morse), Batrachians (Atkinson), fish (Holbrook, De Kay, Morse, Garman and Atkinson), insects (Morse), and crustaceans (Atkinson). The above are references to reports which have not stated definitely that writers have seen or known it eating any of these creatures. Of definite statements we find one by De Kay in which reports he found a Water Snake eating a young pike, and one by Surface,

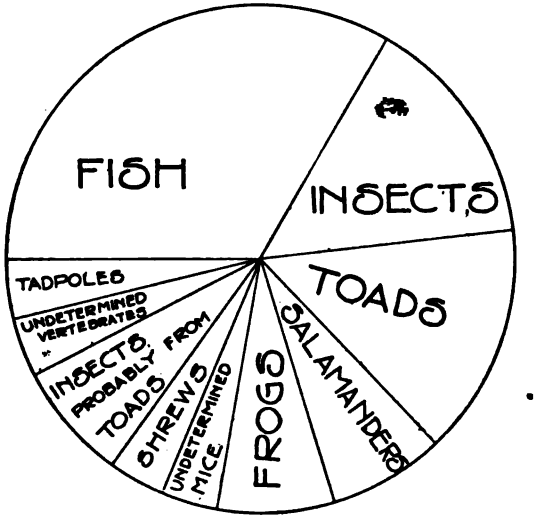


Fig. 10.—Diagram showing the percentages of Food Items of Spotted Water Snake (*Natrix sipedon*): 33 per cent. Fish; 15 per cent. Insects; 15 per cent. Toads; 7 per cent. Salamanders; 8 per cent. Frogs; 4 per cent. Undetermined Mice; 3 per cent. Shrews; 7 per cent. Insects, Probably from Toads; 4 per cent. Undetermined Vertebrates; 4 per cent. Tadpoles.

H. A., "On Removal of Lampreys from the Lakes of New York," 1896, in which he states he found it feeding on the Lake Lamprey, the Bullhead or Black Catfish, the Brook Trout and White Suckers.

While the food of this serpent is generally supposed to be fishes

and frogs, there seems to have been nothing published heretofore concerning the fact that it feeds extensively upon insects and mammals, in addition to fishes and amphibians. These features of its feeding habits should give it a high place in the regards of the husbandman, and while it is one of the most destructive animals in fish ponds and along trout streams, our investigations prove that it may at times have a practical economic value in the destruction of grasshoppers, crickets and meadow mice. Also, while the Water Snake is justly charged with the destruction of Trout at times, it must be recognized that it feeds mostly upon such fishes as White Suckers, Catfish and Star Gazers or species which are enemies of Trout, because they feed upon their eggs and young whenever possible. The evidences, here shown for the first time that it also feeds upon salamanders, tadpoles and toads, as well as frogs, are against it from an economic standpoint, because these creatures are valuable in destroying insects and slugs. On the whole, the Water Snake, although harmless from a physical point of view, must be regarded as one of our objectionable reptiles from the economic standpoint.

The table of food of this species from the seventy specimens which we have examined is as follows:

No. Specimens:	Food Materials:
2	Insect fragments with Toad remains.
1	Undet. Species Orthoptera.
2	Two-striped Grasshoppers.
1	Striped Brown Cricket.
1	Undet. Ground Beetles.
2	Undet. Vertebrates.
6	Undet. Fish.
2	Catfish.
1	White Sucker.
1	Cottus richardsoni.
1	Cottus ictalops.
1	Undet. Salamander.
1	Plethodon cinereus (Salamander).
1	Tadpole.
4	Toads.
2	Green Frogs.
1	Undet. Mammal.
1	Meadow Mouse (Microtus pennsylvanicus).
1	Common Shrew (S. personatus).

The Water Snake is ovoviviparous, bearing its young very late in the season. We have examined specimens of living young in the parent as late in the season as the last of September. From our examinations of the reproductive bodies in the Water Snake we derive certain conclusion as follows:

The undeveloped gonads or eggs are about seven-sixteenths of an inch in diameter, and do not commence to develop until May,

during which month they double in size. In July the yolk is growing smaller and the embryos become one and one-half inches in length. In August the embryo continues to enlarge until it reaches the length of six inches or a little more, and practically absorbs the yolk. In September the yolk is not left, and the young snake reaches the length of eight and one-half inches, at which time it is born.

No. 12. *Callopeltis obsoletus* (Say). **Pilot Snake. Plate XXX.**

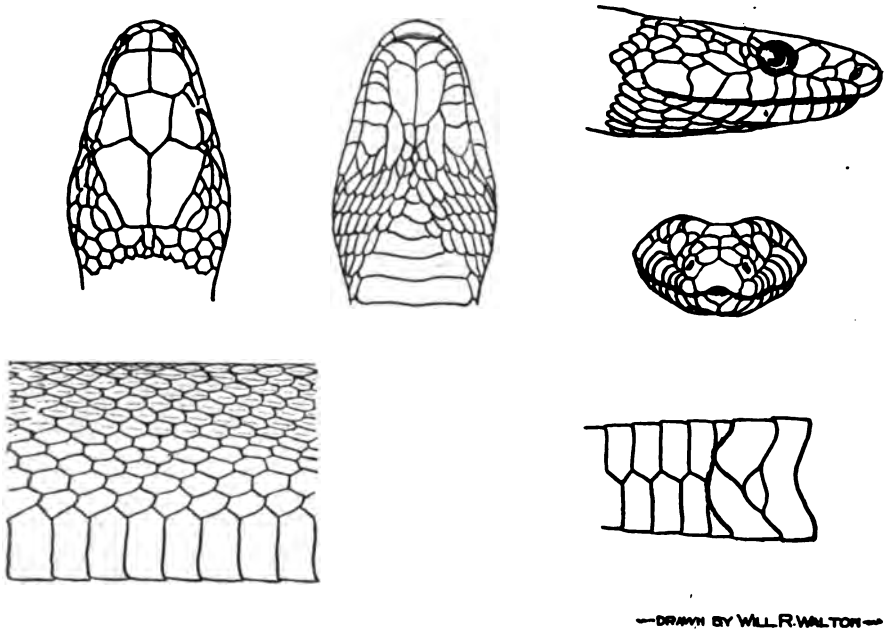


Fig. 11.—Structural characters of Pilot Snake.

This is the species that should properly be called the Pilot Snake, although the name "Pilot" has been given to two or three other species, especially to the Hog-nosed Adder (No. 21) and the Copperhead (No. 22). This confusion of common names has lead to the erroneous popular belief that this snake is poisonous. We occasionally see articles in the papers, especially from the eastern part of the State, stating that persons have been bitten by Pilot Snakes. Upon investigation we have learned that the Copperhead was the one that was meant, and in the region from which the report was circulated it is wrongly called the "Pilot."

This is one of the two large dark-colored snakes commonly called Blacksnakes (Schwartze Schlange, Pennsylvania German), and is distinguished at once from the other species of Blacksnake (No.

16) by the absence of the white chin and throat, and presence of white margins to the scales and irregular blotches on ventral surface.

Coluber is a synonym for *Callopeltis*, and in many publications the scientific name of this snake is given *Coluber obsoletus*. Confusion is avoided by remembering that the two scientific names are synonyms or refer to the same species.

In Pennsylvania we have two species (Nos. 12 and 13) of snakes belonging to the genus *Callopeltis*,—Pilot Snake and Fox Snake, the former of which is very common and the latter is rare. The genus is to be distinguished by the bifid anal plate, by the keeled dorsal scales, which are in either twenty-five or twenty-seven rows, the snout without a keel or plate at the tip, and the ventral plates over two hundred in number. The Pilot Snake differs from its relative, the Fox Snake (No. 13), not only in its darker color but also in having twenty-seven rows of scales instead of twenty-five, as found in that species, and the ventral plates about two hundred and thirty-five instead of not more than two hundred as found in No. 13.

The adult of the Pilot Snake is described as follows: Lustrous black, some of the scales white-edged; under parts slightly black, scales on the middle of back slightly keeled but rest smooth; scales in twenty-seven rows; ventral plates number about two hundred and thirty-five, and length about fifty to seventy-five inches. This snake is entirely harmless, has no poison fangs and carries no venom whatever. It is found from Massachusetts to Illinois and Texas and doubtless occurs in every county in Pennsylvania. We have received it from thirty-six counties, scattered fairly over the State, showing its distribution is general, as follows:

Adams County,	Heintzelman, W. E.,	Ortanna.
Allegheny County,	Couch, Merle,	Carnegie.
	Johnson, Stewart,	Pittsburg.
Armstrong County,	Woods, H. L.,	Apollo.
Bedford County,	Williams, S. W.,	Everett.
Berks County,	Grimm, W. H.,	Hamburg.
Blair County,	Tipton, J. H.,	Tyrone.
Cambria County,	Uncapher, D. H.,	Ebensburg.
Carbon County,	Murphy, A. and E.,	Summit Hill.
Columbia County,	Baldy, S.,	Catawissa.
Cumberland County,	Garber, S. R.,	Entlersville.
	Hess, I. C.,	Shiremanstown.
Elk County,	Schreiber, A.,	Dagus Mines.
Erie County,	McCord, W. F.,	Northeast.
	Lyon, G. A.,	Miles Grove.
Fayette County,	Lyons, W. T.,	Cheat Haven.
Fulton County,	Houck, R. C.,	McConnellsburg.
Greene County,	Bucher, Prof. J. G.,	Waynesburg.

Huntingdon County,	Elias, M. J.,	Cole's Summit.
	Swoope, J. P.,	Huntingdon.
	Leffard, J. H.,	Huntingdon.
Indiana County,	Yukenberger, H.,	Indiana.
	Wehrle, R. W.,	Indiana.
Juniata County,	June, Jas.,	McCoysville.
	Yoder, C.,	Pleasant View.
Lawrence County,	Hawthorne, L. H.,	New Castle.
Lebanon County,	Bohn, J. G.,	Onset.
Luzerne County,	Fink, J. B.,	Shickshinny.
Lycoming County,	Drill, J. H.,	Cogan House.
Mifflin County,	Harshberger, J. F.,	Strode's Mills.
	Rogers, L. B.,	Newton Hamilton.
Monroe County,	Allegar, I. L.,	Shawnee.
Montour County,	West, G. P., Mrs.,	Gates.
Northumberland County,	Swank, B. F.,	Crowl.
Perry County,	Brightbill, H. A.,	Marsh Run.
	Hooke, B. P., Jr.,	Landisburg.
	Brightbill, M. C., Mrs.,	Marsh Run.
	Wagoner, J. C.,	Landisburg.
Snyder County,	Keller, W. I.,	Beaver Springs.
Washington County,	Couch, Jos.,	Hickory.
	Stewart, R. A.,	Independence.
Westmoreland County,	Wagner, W. J.,	New Florence.
Wyoming County,	Knuppenberg, D. A.,	Lake Carey.
	Baldwin, F. M.,	Skinner's Eddy.
	McMickens, N. C.,	Meshoppen.
	Cartwright, W. M.,	Meshoppen.
York County,	Johnson, J. Q.,	Slab.

The Pilot is one of the largest Blacksnakes, and often climbs trees or runs over bushes. It takes advantage of its tree-climbing ability to reach the nests of birds and take therefrom the eggs or young as well as enter the holes of squirrels for the young, upon which they feed. It often lies for hours basking in the sun, and at times when disturbed may take advantage of the fright of its fleeing pursuer to chase after him. We have experimented with this and the Blue Racer (No. 16), running from them to see them follow us, but when we turned upon them and became their pursuers they would not venture to attack, but turned and fled. This is also a harmless snake, and the stories of its attempting to choke or strangle men, women and children are no doubt in all cases without proof or truth.

The Pilot Snake is oviparous or lays eggs, and our dissections show that its eggs commence to develop during the month of June. These become about one and three-fourth inches in length, and are covered with a thin, smooth, leathery shell and are laid during the latter part of August or early part of September. From one to two dozen of them are laid in loose earth or damp sawdust, where the heat of the sun will hatch them. We have had them hatch

during the first and second weeks of September. The young snakes commence to strike and fight and defend themselves before they are out of the shell. At the time it leaves the shell it is nearly one foot in length, and so spotted in color that it is thought by most persons to be a Spotted Adder, or House Snake or almost any other kind of spotted snake excepting the Pilot or Smooth Black Snake.

The food of the Pilot Snake has been reported by writers to be as follows: Birds' eggs (Maximilian, Cope and Garman); rats, rabbits and small animals (Cope, E. D.); mammals, birds and batrachians when in captivity (Atkinson). Prof. Cope definitely records that he found it eating wild mice. Our investigations show definitely a much more extended list of the elements of food substances, as given in the following table:

No. Specimens:	Food Materials:
4	Undet. Insect fragments.
1	Undet. Larvæ.
4	Insects, with Bird remains.
1	Undet. Species Orthoptera.
2	Acrididæ (Grasshoppers).
1	Woods Frog.
11	Undet. Birds.
1	Undet. Eggs.
1	Chicken Eggs.
1	Robin Eggs.
1	Red-winged Blackbird.
1	Sparrow.
1	Robin.
4	Undet. Mammals.
2	Common Opposum.
3	Undet. Mice.
3	Meadow Mouse. M. pennsylvanicus.
1	Microtus sp. (Uncertain species.)
2	House Mouse.
1	Undet. Squirrels.
4	Red Squirrels.
1	Chipmunk.
1	Undet. Shrew.
2	Weasles.

From the above list of food, it will be seen that the Pilot feeds upon birds of various kinds and also on their eggs. These are generally species that nest in bushes or near the ground. The eggs of chickens and robins have been definitely determined in their stomachs, while we have found also red-winged Blackbirds, Sparrows and Crow-blackbirds eaten by them. Among the mamma's are the opossum and the very destructive meadow mouse and house mouse, as well as squirrels, chipmunks, shrews and weasels. The insects eaten are also to be considered, as these are species that are obnoxious to the interests of man.

PLATE XXVII.—Black Snake (*Bascanion constrictor*).
Photographed in Nature by Mr. Wm. H. Fisher, Baltimore.

PLATE XXVIII.—Black Snake (*Bascanton constrictor*), one-fourth Natural Size.
Photographed in the Office of the State Zoologist of Pa.

PLATE XXIX.—Young Black Snake (*B. constrictor*).
Photographed in Nature by Mr. Wm. H. Fisher.

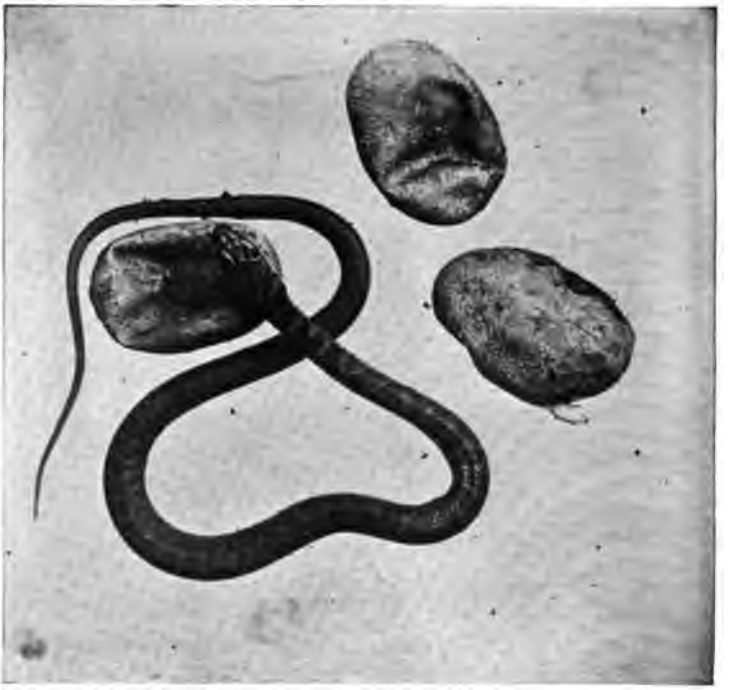


PLATE XXX.—Fig. a. Newly hatched Young and Eggs of Black Snake (*B. constrictor*), about half natural size.

Hatched and Photographed alive in the Office of the State Zoologist of Pa.

PLATE XXX.—Fig. b. Ground Snake (*Carphophiops amœnus*).

Photograph of a Pennsylvania Specimen in the Office of the Economic Zoologist of Pa.

In making a study of the food of the Pilot in relation to the time of year in which it was taken, we observe that during the early part of the summer the predominating feature consists of eggs or young birds, and thus at this time of year it is economically objectionable; (see Food Chart 12 B) while during the latter part of the summer it consists to a great extent of mice and other obnoxious mammals, (see Food Chart 12 C) and from the economic standpoint at this time

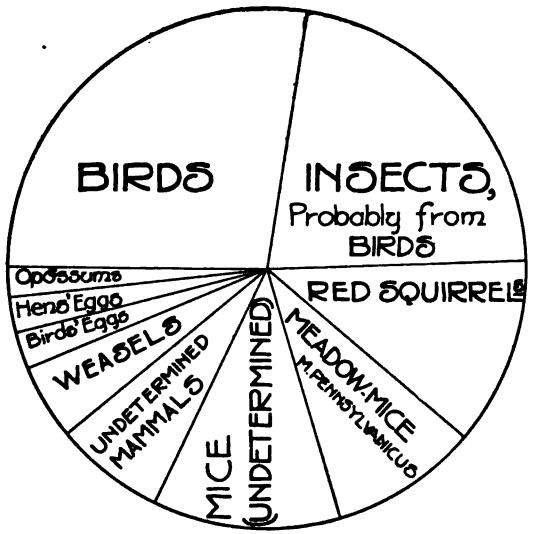


Fig 12a.—Diagram showing the percentages of Food Items of Pilot Snake (*Callopeltis obsoletus*): 11½ per cent. Red Squirrels; 2 per cent. Oppossum; 28 per cent. Birds; 2 per cent. Birds' Eggs (Undetermined); 4½ per cent. Weasels; 10 per cent. Meadow Mice (Microtus pennsylvanicus); 2 per cent. Hens' Eggs; 21 per cent. Inseots (Probably from Birds); 7 per cent. Undetermined Mammals; 12 per cent. Mice (Undetermined).

of year it is to be considered as beneficial. It is impossible to strike a balance and say that this creature is so objectionable from an economic standpoint as to deserve destruction, nor so beneficial at all times as to justify preservation. We can only indicate what we have found and say that further studies are necessary before final conclusions are to be reached.

No. 13. *Callopeltis vulpinus* (B. & G.) **Fox Snake.**

The Fox Snake is so called because of its light brown color, and while it is more or less common and in some of the northern states, it is not a common species in Pennsylvania. It is given as a Pennsylvanian species upon the authority of *Jordan*, and is recorded as occurring from Massachusetts to Kansas and northward. Thus

it is a northern species and more liable to be found in the northern section of this State than in the southern. While it has the characters of the genus *Callopeltis*, as given above, it differs from the Pilot Snake in the color being light brown with four-sided chocolate-colored blotches, scales in twenty-five rows and the ventral plates not over two hundred and ten. We respectfully invite correspondence upon this species and desire specimens of the same.

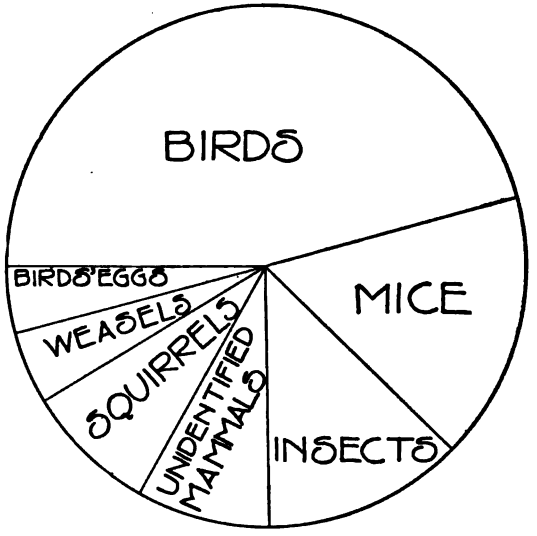


Fig. 12b.—Diagram showing the percentages of Food Items of Pilot Snake (*Callopeltis obsoletus*) found during the months of June and July only; 46 per cent. Birds; 16½ per cent. Mice; 12½ per cent. Insects; 8½ per cent. Unidentified Mammals; 4 per cent. Weasels; 4 per cent. Birds' Eggs.

Very little is known or published concerning the food of the Fox Snake. Prof. Cope has published that it feeds on "vermin of various kinds," and also that he found it eating a rabbit. It is probable that to a great extent its food consists of mice, rats, rabbits, frogs, toads and such birds as it can capture.

No. 14. *Opheodrys æstivus* (L.) Green Snake. Plate XXVI.

In the State of Pennsylvania there are two species of snakes green in color. One of these (No. 14) is known as the Green Snake, and the other as the Grass Snake. The former is rare in this State and the latter rather common. While both are small, harmless, uniformly green above and yellowish beneath, they differ considerably in certain structural characters. This species can be called the 'Keeled Green Snake," because all the scales have keels on them or are roughened. The Grass Snake (No. 15) can be called

the "Smooth Green Snake," because the scales are not keeled. In both, the anal plate is divided or bifid. The Green Snake has about one hundred and fifty-five ventral plates, while the Grass Snake has only about one hundred and forty. With the former the tail is more than one-third the length of the entire body, and with the latter the tail is less than one-third its entire length. The Green Snake is described as having a conical head; neck very small; color bright clear green, yellowish below; scales in seventeen rows; ventral plates one hundred and fifty to one hundred and sixty-five; tail more than one-third of the body, and the length reaching thirty inches.

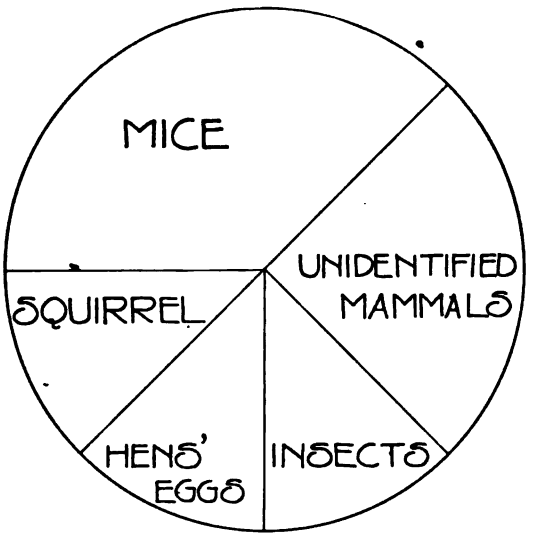


Fig. 12c.—Diagram showing the percentages of Food Items of Pilot Snake (*Callopeltis obsoletus*) found during August and September only: 37½ per cent Mice; 25 per cent. Unidentified Mammals; 12½ per cent. Insects; 12½ per cent. Hens' Eggs; 12½ per cent. Squirrels.

This snake is found from southern New Jersey to Indiana and southward, and is abundant in the southern part of the country. It is a beautiful little snake, living on bushes and trees, as well as among grass, and is shown by our Plate No. XXVI to be quite at home in a tree. It feeds more upon insects than upon other creatures, and as it is entirely harmless should be protected rather than destroyed. We regret that we have been able to study only two specimens of this species from this State. One is from Lancaster county and the other from Dauphin county, Pa. There are a few from Pennsylvania in other collections. We respectfully request readers to send us specimens of the green colored snakes which they may meet in their rambles. They are absolutely harmless.

The Green Snake is certainly one of our most beneficial reptiles as an insectivorous creature, and the few authors who have published notes on it are doubtless correct as follows:

Shaw, in his "General Zoology," says it feeds on flies and other insects, and Holbrook and Garman each report it as eating insects. These are the only published statements which we find referring to its food.

No. 15. *Liopeltis vernalis* (DeKay). **Grass Snake.**

The Grass Snake is not especially rare in the State of Pennsylvania, although it is not often observed, owing to the fact that it lives in the grass and among the foliage where its green color renders it inconspicuous. We have received twenty-nine specimens from counties listed below:

Adams County,	Myers, D. W.,	Gettysburg.
	Oslan, C. L.,	Aspers.
Allegheny County,	McCutchens, J. C.,	Pittsburg.
Beaver County,	Walls, R. B.,	Saxton.
Berks County,	Kline, R. H.,	Berneville.
Cambria County,	Dishart, H.,	Patton.
Centre County,	Benner, C. A.,	Powelton.
	Kennedy, Prof. J.,	Powelton.
Erie County,	Baron, E. A.,	McKean.
Fayette County,	Lange, W. H.,	Belle Vernon.
Franklin County,	Miller, J. B.,	Chambersburg.
	De Long, A. C.,	Mont Alto.
	Atkinson, Mr.,	Mont Alto.
Fulton County,	Hess, J.,	Dublin Mills.
Indiana County,	Wehrle, R. W.,	Indiana.
Juniata County,	Jameson, T.,	Swales.
Luzerne County,	Angus, W.,	Stoddartsville.
Lycoming County,	Nelson, Foster,	New Berry.
Monroe County,	Burdsall, F. H.,	Effort.
	Coggler, B. G.,	Tobyhanna.
Perry County,	Brightbill, H. M.,	Marsh Run.
Somerset County,	Suhrie, J. E.,	Crumb.
Sullivan County,	Wieland, W. S.,	Nordmont.
Union County,	Benner, W. E.,	Vicksburg.
Washington County,	Couch, Jos.,	Canonsburg.

As these are fairly well scattered over the State it shows that its distribution is no doubt general. It is to be recognized by its green color and smooth glossy scales without keels. It is described as having head elongate; neck slender; eyes generally large; uniform deep green (turning bluish in spirits), yellowish below; tail not quite one-third the length; scales fifteen; ventral plates one hundred and twenty-five to one hundred and forty, and length twenty-five inches or less.

This most beautiful and harmless little snake is found throughout the eastern United States and differs from the preceding in

being more common northward than southward. It lives where vegetation is abundant and is no doubt to a considerable extent nocturnal. It lays eggs, as is shown by the fact that we have received snake eggs and upon opening them found well developed little embryos representing this species of serpent.

The eggs, according to our dissections, commence to develop in June and reach the full length (1½ in.), by the middle of August, about which time they are laid. The egg shell is translucent, thin, and parchment-like, and the little embryo within the egg is about an inch long at the time it is laid. The laying may occur from the 12th of August to the 15th of September. The eggs probably hatch within three weeks after the time of laying. They are deposited in loose earth, decaying wood, or sawdust, and the young soon find protection in concealment in the grass or green foliage.

The Grass Snake has been reported as feeding on insects (DeKay and Morse) and "crickets and grasshoppers" (Holbrook). Dr. Atkinson has published that he found three grasshoppers in one specimen of this serpent.

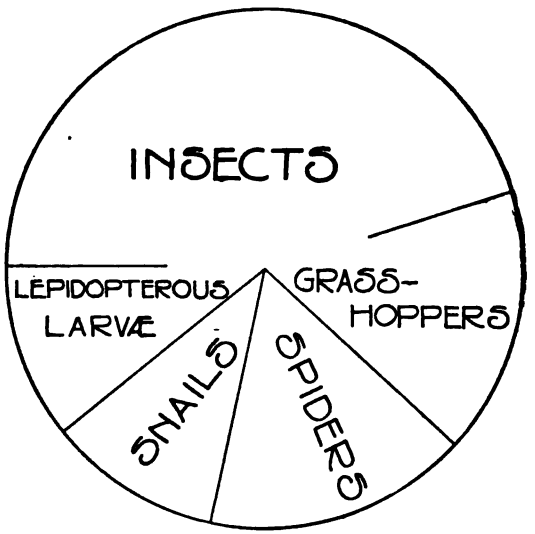


Fig. 13.—Diagram showing the percentages of Food Items of Grass Snake (*Liopeltis vernalis*): 45 per cent. Insects; 16 per cent. Spiders; 17 per cent. Grasshoppers; 11 per cent. Lepidopterous Larvæ; 11 per cent. Snails.

From our actual studies of the food contents of 22 specimens we have ascertained the following:

No. Specimens:	Food Materials:
1	Helix hirsuta (Snail).
1	Slug.
1	Snails. Undet.

3	Spiders.
2	Undet. Insect fragments.
2	Undet. Larvæ.
1	Undet. Species Orthoptera.
2	Acrididæ (Grasshoppers).
2	Common crickets.
2	Striped Brown Crickets.
2	Undet. Lepidoptera.
1	Measuring Worms.
1	Ground Beetles (Harpalus sp.)
1	Red Ants.
1	Striped Salamander.

In the above table we find that most of the food materials mentioned are obnoxious to the interests and property of mankind, excepting the ground beetles and the striped salamander, which are insectivorous. Consequently we must say emphatically that an animal with such a menu must be very valuable to mankind in destroying the obnoxious insects and other pests around him. The absence of toads and fragments of toads from this list shows they do not feed on these useful batrachians, and also that the insects found in their stomachs were taken by them primarily as their own food, rather than secondarily as the food of the toads which were swallowed, as is evidently the case with the Garter Snake and the Hog-nosed Adder or Blowing Viper.

The above table proves conclusively that the Grass Snake is beneficial, as it feeds upon small snails, slugs, spiders, grasshoppers, crickets, measuring worms and other objectionable insect larvæ, and red ants, with an occasional salamander for variation, yet very few amphibians are taken as its food. Were it not for the two eating ground beetles and one specimen of salamander included in the above list, we could say that all these individuals showed absolutely beneficial characters in their feeding habits. As an animal that needs preservation in order to help suppress the increasing numbers of insect pests, the harmless and beautiful little Grass Snake is to be recommended. Let its utility be taught in the home and school and these useful creatures preserved.

No. 16. *Bascanion constrictor* (L.) Black Snake. Plates XXVII, XXVIII, XXIX, XXX Fig. a.

The Black Snake is also called the "Blue Racer" from the fact that it has a bluish lustre and runs rapidly, especially over vines and thickly growing bushes. It differs conspicuously from the other species of Black Snake (No. 12), called the Pilot Snake, by the presence of the white on throat and chin only, also in having all the scales smooth instead of keeled. The genus Bascanion, of which we have but one species in this State, does not have the dorsal scales keeled; the anal plate is bifid; the scales are generally in seventeen

rows, and the ventral plates are one hundred and eighty-five in number. The *B. constrictor*, which is commonly known as Black Snake or Blue Racer (Schwartze Schlange, in Pennsylvania German), is to be known by its lustrous pitch black color, which is bluish or greenish below, and the white throat and chin, very large eyes, scales generally seventeen, ventral plates one hundred and seventy to one hundred and ninety, and length five feet or less. It may at times be found larger.

It is not generally known that the young are a grayish olive color, spotted with rhomboid black botches or spots, and few persons recognize young Black Snakes because they expect to see them black, rather than spotted. Most persons take them to be the young of the House Snake (No. 20), Water Snake (No. 11), or the Copperhead (No. 22). The Black Snake or Blue Racer is entirely harmless and does not voluntarily attack any person, although it is true that when angered it may pursue its tormentor if the latter should turn and flee. This snake is found in the eastern United States and is very common eastward and southward. We have received it from thirty counties and it is beyond any doubt to be found in the other counties of this State. It is among the more common species of larger snakes, in more or less wooded regions and along hillsides and among bushes.

The following is our Pennsylvanian record:

Adams County,	Bream, T. F.,	Gettysburg.
Beaver County,	Elder, T. S.,	Darlington.
Berks County,	Gruber, Prof. C. L.,	Kutztown.
Blair County,	Marder, G. A.,	Altoona.
Bradford County,	Robinson, J. S.,	Milan.
Bucks County,	Atkinson, J. W.,	Buckingham.
	Cox, E. C.,	Buckingham.
	Fosbeiner, J.,	Richland Centre.
	Bewley, Miss Anna K.,	Forest Grove.
Centre County,	Harpster, J. S.,	Port Matilda.
Clinton County,	Moran, E.,	Lock Haven.
Crawford County,	Coon, O. O.,	Saegertown.
Dauphin County,	Whitauer, C. B.,	Steelton.
Fulton County,	Millott, P. C.,	Andover.
	Palmer, A. C.,	Warfordsburg.
	Schenck, J. M.,	Enid.
Erie County,	Mixer, E. W.,	Waterford.
Huntingdon County,	Swoope, J. P.,	Huntingdon.
Indiana County,	Wehrle, R. W.,	Indiana.
Lebanon County,	Bohn, J. G.,	Onset.
	Peiffer, L. S.,	Fredericksburg.
	Bohn, J.,	Lickdale.
Lehigh County,	Dickenshied, F. S.,	Hosensack.
Luzerne County,	Patterson, J. E.,	Wilkes-Barre.
	Shovlin, H. A.,	Freeland.

Lycoming County,	Shafer, W. H.,	Cogen House.
	Drill, H.,	Cogen House.
	Sarson, W.,	Okome.
Monroe County,	Allegar, I. L.,	Shawnee.
Perry County,	Brightbill, H. A.,	Marsh Run.
	Brightbill, H. M.,	Marsh Run.
Schuylkill County,	Moyer, M.,	Schuylkill Haven.
Somerset County,	Suhrie, J. E.,	Crumb.
Venango County,	Bean, Lauella,	Emlenton.
Washington County,	Couch, Jos.,	Hickory.
	Couch, Merle,	Canonsburg.
Wayne County,	Bullock, W. H.,	Honesdale.
Wyoming County,	Sharpe, A. B.,	Jenningsville.
York County,	Johnson, J.,	Woodbine.

Both species of Black Snakes are reputed enemies of Copperheads and Rattlers, and the effectiveness of Black Snakes in destroying these two venomous species is so generally believed and reported to us we must believe that there is enough truth in it to warrant the belief in the common assertions that the Black Snakes attack, kill and eat Copperheads and Rattlers. However, we have not been able to find specimens of this venomous species of reptile in the stomachs of Black Snakes, although we have found them eating Garter Snakes, Water Snakes and Grass Snakes. Prof. Verrill, of Yale, found a Copperhead in the stomach of one of this species. It is remarkable how the snakes of this species can climb trees and walls and how rapidly they can run over bushes and through branches. We remember chasing one nearly one hundred yards as it ran over bushes and vines four or five feet above the ground, while the writer was running the same distance on practically open sod ground.

The Black Snake or Racer multiplies by laying eggs, which are one and one-half to one and five-eighths inches in length, oval in shape and twenty to forty in number, deposited two or three inches below the surface of loose soil into which the reptile bores, or in piles of sawdust, hollow logs or trees or decaying wood. The embryonic snake at the time of hatching is nearly one foot in length and is of such a light color and so spotted that it is seldom believed to be a Black Snake.

The eggs are laid during the latter part of June or early part of July, and the last of the latter month the embryo shows typical color markings. They generally hatch during the latter part of August or early part of September. We have collected them (our specimen No. 1636) hatching as late as October. We have evidence from correspondence which will be published later, that the young may remain in the egg during the entire winter and not hatch nor become active until the following spring. The shell is generally white

and elongate, with rough points, and the young fight, strike and defend themselves as soon as their heads are out of the shell. They cut their way through by means of an egg-tooth projecting from the middle of the upper snout, having for its function the slitting of the leathery shell through which the animal crawls, after which the egg-tooth is shed.

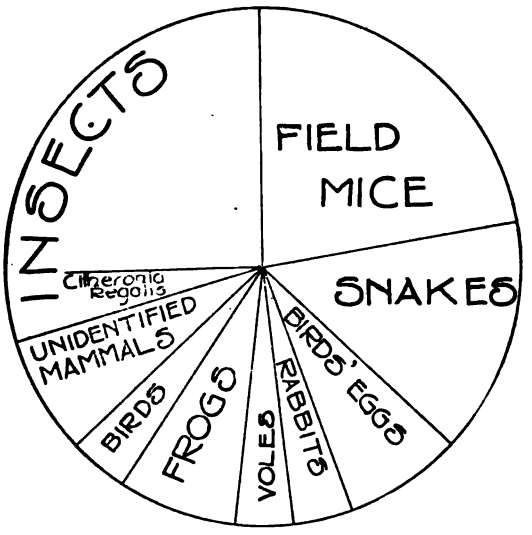


Fig. 14.—Diagram showing the percentages of Food Items of Black Snake (*Bascanion constrictor*): 25 per cent. Insects; 15 per cent. Snakes; 22 per cent. Field Mice; 8 per cent. Birds' Eggs; 4 per cent. Rabbits; 4 per cent. Voles; 7½ per cent. Frogs; 4 per cent. Birds; 7 per cent. Mammals (unidentified); 3½ per cent (*Citheronia regalis*). Larvæ of Royal Moth.

Writers have reported the Black Snake as feeding upon a great variety of substances as follows: Small mammals (Atkinson), mice and rats (Shaw and Cuvier), field mice (Garman and Smith), squirrels and opossums (Cuvier), small quadrupeds (DeKay), milk, in pans (Shaw), birds (DeKay, Garman, Smith, Cuvier, Atkinson and Harlan), eggs (Shaw, DeKay, Morse and Harlan), lizards (Cuvier), rattle snakes (Shaw), batrachians (Atkinson), toads (DeKay), frogs (DeKay, Garman, Smith and Cuvier), and insects (Morse). Very few persons have published anything definite as to the species of these various animals upon which they feed. Dr. Atkinson, of Carnegie Museum, has taken weasels and voles from their stomachs, but as a rule specific statements of their food have not been given by other writers. Our investigations show the following list of food for different individuals of this species:

No. Specimens:	Food Materials:
3	Undet. Insect fragments.
1	Insects, with Frog remains.
1	Acrididæ (Grasshoppers).
2	Cave Crickets.
2	Undet. Lepidoptera.
1	Cecropia Moth.
2	Imperial Moths.
2	Regal Moths.
1	Common Cutworms.
2	Undet. Beetles.
1	Undet. Ground Beetles.
1	Long-Horned Leaf Beetles.
2	Clover Leaf Beetles (P. punctatus).
1	Undet. Saw Fly.
1	Currant Worms.
1	Ichneumonidæ.
1	Woods Frog.
1	Green Frog.
2	Garter Snake.
1	Water Snake.
1	Grass Snake.
1	Undet. Bird.
2	Robins' eggs.
3	Undet. Mammals.
1	Rabbit.
1	Undet. Mice.
4	Meadow Mice (M. pennsylvanicus).
2	Microtus sp. (uncertain species).
1	Vole. (Evotomys sp.)

In the above extensive list of food materials we find that the Black Snakes have eaten meadow mice (*Microtus pennsylvanicus*) more than any other one material found in their stomachs. Among the economically objectionable food materials which they had taken are grasshoppers, cave crickets, moths and cutworms of different species, leaf beetles, especially clover-leaf beetles, saw flies, currant worms and meadow mice and voles. The list of beneficial food materials are frogs, ichneumon flies, grass snake, bird, robbins' eggs and rabbit. An important feature of this table is that it shows that the Black Snake eats other snakes, such as Garter Snakes and Grass Snakes, and there is no doubt in our mind of the truth of the generally accepted statement that it is an enemy of the Rattler and Copperhead.

In striking the balance in the food of the Black Snake it can not now be decided in favor of this reptile, as the above list shows that it is more obnoxious than beneficial. It is true that an individual serpent may form the habit of frequenting the hen house or chickens' nests to seek and eat their eggs, and the proper thing to do in such a case as this is to meet the trouble by killing the

molester. From individual stomach records we learn certain facts that are not to be obtained from the general list, such as that given above in the form of a food chart of this serpent. One of the very significant points is that a bird, snake or frog was present in almost every stomach which contained insects, unless that were large larvæ. It is very evident that the Black Snake does not eat any but the largest insects, such as the larvæ of the Royal Moth and of the Sphinx moths, but it does feed upon insectivorous creatures to a great extent and the latter furnished the smaller insects and fragments which were found within those that were studied. Thus, it appears to be more destructive than beneficial, as the present evidences appear to be against it. More studies are needed for our final verdict, which must be reserved until more complete and satisfactory evidences are obtained.

No. 17. *Pituophis melanoleucus* (Daudin). **Pine or Bull Snake.**

The Pine Snake is one of the species of serpents that probably occurs in Pennsylvania, although we have not yet been fortunate enough to secure specimens and find no definite record of it having been collected in this State. It is also called the Bull Snake, and lives in pine woods, from which it takes its common name. Its general ground color is whitish, with chestnut brown blotches, which are margined with black, and three series of blotches on the sides. This is one of the two genera with the dorsal scales keeled and the anal plate entire. The scales are in twenty-nine rows, the ventral plates about two hundred and twenty-five in number, and the greatest length about six feet. It is recorded as feeding upon rabbits, squirrels, birds, etc., and we desire specimens in order to make more definite studies.

No. 18. *Diadophis punctatus* (L.) **Ring-necked Snake.**

The little Ring-necked Snake is commonly seen in the early spring in most parts of this State, on dry paths, sunning itself. It is a beautiful, interesting and harmless species, which never attains a size of more than one and one-half feet in length, and is to be recognized by its smooth scales, the bifid anal plate, scales in fifteen rows, ventral plates about one hundred and forty or more in number, and bluish black in color, with a yellow collar or ring about the neck. This ring is about two scales wide and is quite conspicuous. Beneath, the color is orange yellow, becoming bluish in spirits. Each plate of the under side usually has a black spot on it at each side, and some times one in the middle.

This harmless little snake is recorded as being a western species, occurring eastward to Ohio, yet our investigations must extend its

range, as we have collected or received it from the counties listed in a following table:

Adams County,	Hartman, E. W.,	Cashtown.
Beaver County,	Mansfield, I. F.,	Beaver.
Bedford County,	Beemiller, Frank,	Bedford.
Berks County,	Dengler, J. E.,	Tulpehocken.
Blair County,	Riddle, Miss Bertha,	Bushman.
Bradford County,	Seward, F. H.,	Wyalusing.
Cambria County,	Uncapher, D. H.,	Ebensburg.
Chester County,	Mast, A. H.,	Elverson.
Clearfield County,	Care, J. G.,	Irvona.
Columbia County,	Stahl, H. R.,	Light Street.
Franklin County,	De Long, C. A.,	Mont Alto.
Huntingdon,	Mierley, K. W.,	Mapleton Depot.
	Fouse, C. S.,	Aitch.
Indiana County,	Wehrle, R. W.,	Indiana.
Jefferson County,	Brian, Chas.,	Brockwayville.
Lackawanna County,	Croasdale, W. D.,	Chinchilla.
Lawrence County,	Hawthorne, L. H.,	New Castle.
Lehigh County,	Kocher, J. F.,	Walberts.
Lycoming County,	Van Housen, Bruce,	Williamsport.
	Spencer, Douglas,	Williamsport.
Perry County,	Brightbill, H. A.,	Marsh Run.
	Callender, G. S.,	Duncannon.
Snyder County,	Keller, W. J.,	Beaver Springs.
Somerset County,	Suhrie, J. E.,	Crumb.
Sullivan County,	Wieland, W. S.,	Nordmont.
Washington County,	Couch, Merle,	Canonsburg.

It is no doubt to be found in almost every county in the State, as it is to be seen that the list given above represents nearly all parts of Pennsylvania. It is to a considerable extent nocturnal in habits, and during the day time is often found beneath stones, logs or bark. Its dark color renders it nearly the color of the damp soil where it lives. It depends upon its protective coloration for concealment. The largest specimen which we have received is seventeen and one-half inches in length. This is from Cannonsburg, Washington county.

There has been almost nothing published about the reproductive methods of the Ring-necked Snake, but we are prepared to state here positively that it is oviparous, or lays eggs. The latent gonads or undeveloped eggs are one-fourth inch in length and commence to develop in May, when they reach a length of one-half inch, and by the middle of June they are practically developed, or over one inch long. They are laid from the middle of June to July or August and each is covered with a thin opaque shell, white and leathery, and very irregular in shape and size. They hatch in September and October, and the young are about four inches in length at the time of hatching.

As far as we can learn, this is the only definite statement that has ever been published about the reproduction of the Ring-necked Snake, excepting a statement by Dr. Atkinson to the effect that he had found ten eggs in a specimen taken by him July 9th, and that from the thickness of the shell enveloping them there were indications that the species is oviparous. When we receive enough specimens we shall try to work out the full life history of this valuable little serpent.

Authors have published various reports about the food of this little Ring-necked Snake. It is said to feed upon reptiles (Cope); batrachians (Cope); toads (Morse); insects (Holbrook, Cope, Morse and Atkinson); and worms (DeKay and Atkinson). Atkinson found beetles and earthworms in one.

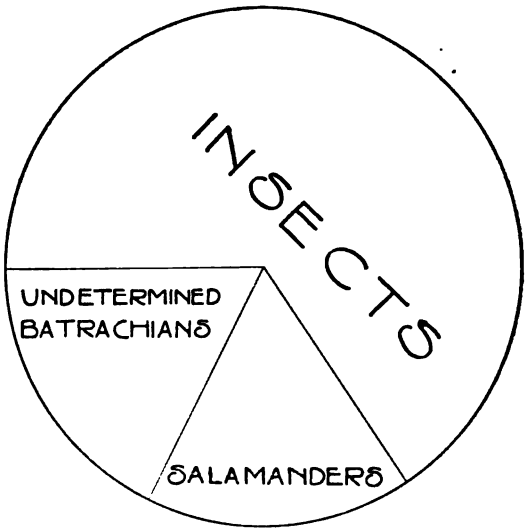


Fig. 15.—Diagram showing the percentages of Food Items of Ring-necked Snake (*Diadophis punctatus*): 66 per cent. Insects; 16 per cent. Undetermined Batrachians; 17 per cent. Salamanders.

Of the twenty specimens which we have examined, sixteen contained no food, two contained undetermined insect fragments, one contained undetermined beetles and Ground Beetles; in another we found an undetermined salamander, and in another a Striped Salamander (*Plethodon cinereus*). This indicates its beneficial feeding habits, as it appears its chief food consists of earthworms and insects, rather than batrachians (excepting salamanders) and reptiles, as some have reported. With this, as with other species, more specimens are needed for further investigations and final conclusions.

No. 19. *Lampropeltis getulus* (L.) *Var. sayi* (Holb.). **Chain or Thunder Snake, King Snake.**

The Chain Snake is so named from the coloration or color pattern, which gives the appearance of chains extending along the body. It is also called the Thunder Snake, and one variety is known as the King Snake. The genus *Lampropeltis* is to be recognized by the absence of keels from the scales; the anal plate entire; ventral plates one hundred and eighty in number; scales in twenty-one to twenty-five rows. *L. getulus* is described as black with narrow yellowish lines forking on the sides, each fork embracing a large black spot; color chiefly black; belly checkered; scales in twenty-one rows; ventral plates two hundred and ten to two hundred and forty; length fifty inches or less. While this is commonly found from Virginia to Louisiana, mostly east of the mountains, the Yellow-spotted Black Snake or King Snake, which is another variety, is found from the Alleghenies to the Rocky Mountains, we have not collected nor received specimens in the State of Pennsylvania and insert it here on the authority of Dr. Jordan, in his Manual of Vertebrates, who gives it from "the Allegheny to the Rocky Mountains." We find no author who has made definite observations upon its food, but it is reported commonly by writers that it feeds upon batrachians, such as salamanders and toads, and reptiles, such as rattle snakes, moccasins and lizards, and also on birds and moles. This reptile is so well marked that it should be recognized, even by one who is not an expert, and as we are anxious to receive specimens of it we invite readers to help us procure it.

No. 20. *Lampropeltis doliatus* (L.) *triangulus* (Boie.) **Milk Snake or House Snake. Plate XXXI.**

The House Snake or Milk Snake is among the most numerous of the snakes of Pennsylvania, and is known by a greater variety of names than is any other one species. It is variously known as the House Snake, Milk Snake, Chicken Snake, Thunder and Lightning Snake, Red Snake, Horn Snake, Chequered Snake, Milk Adder, Spotted Adder and "Blotshich Schlange" in Pennsylvania German. The latter is one of the most common names in some places. It is known by its grayish color, with three series of brown rounded blotches bordered with black; about twenty-five in the dorsal row. It has an arrow-shaped blotch or spot on the top of its head, with the point of the arrow extending toward the tail, and the under side is light, with a great many square or rectagular black blotches. These small square black marks on the under side at once distinguish it from all other species of reptiles found in his State. While the

tail is short, it is not as stumpy nor as heavy as the tails of the two venomous species of serpents which we have. The largest specimen which we have collected is forty inches, and the smallest specimen is nine inches long.

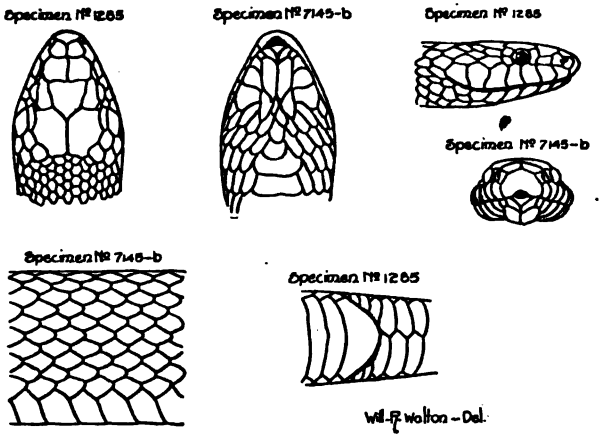


Fig. 16.—Structural Characters of House Snake (*Lampropeltis doltatus triangulus*).
Natural Size. Drawn under Supervision of H. A. Surface, Economic Zoologist.

The House or Milk Snake, or Spotted Adder, is found from Virginia to Iowa and northward and occurs throughout Pennsylvania as the most common snake in the State, excepting the Garter Snake. We have received it from the following forty-eight out of sixty-seven counties in this Commonwealth, and it, of course, is found in the other counties:

Adams County,	Sprenkel, E. A.,	Fairfield.
Allegheny County,	Johnson, Stewart,	Pittsburg.
	Brumbaugh, C. L.,	Wilkinsburg.
	Walker, R. L.,	Carnegie.
	Couch, W.,	Carnegie.
	Reed, C. G.,	Bridgeville.
	Cruikshank, Dr. O. T.,	Swissvale.
Beaver County,	Walls, R. B.,	Saxton.
	Doughty, G.,	Smiths Ferry.
Bedford County,	Williams, L. S.,	Everett.
Berks County,	Neithamer, E. F.,	Reading.
	Becker, W. D.,	Fleetwood.
	Grimm, W. H.,	Hamburg.
	Dengler, J. E.,	Tulpehocken.
Bradford County,	Huffman, J. L.,	New Albany.
Bucks County,	Oppenlander, E.,	Passer.
	Godshalk, S. Y.,	Perkasie.
Cambria County,	Dishart,	Patton.

Carbon County,	Salt, H. E.,	Weissport.
	Murphy, J. H.,	Summithill.
	Davis, Russel,	Lansford.
Centre County,	Kuhn, C. T.,	State College.
Chester County,	Baldwin, O. H.,	Parkersburg.
	Keim, J. H.,	St. Peters.
Clarion County,	Cyphert, P.,	Crates.
	Arnold, F. M.,	Clarion.
Clearfield County,	Hund, W. E.,	La Jose.
	Green, J. W.,	McCartney.
Clinton County,	Williams, J. M.,	Floral.
	Caprio, S.,	Lock Haven.
Columbia County,	Kuhler, K. L.,	Benton.
Crawford County,	Gilmore, L. B.,	Saegerstown.
	Hanks, A. J.,	Wilson Mills.
	Miller, W. H.,	Guy's Mills.
	Martin, J. T.,	Meadville.
	McFate, D.,	Meadville.
Cumberland County,	Hull, R. J.,	Lisburn.
	Grosz, F.,	Balfour.
	Ritchey, Mrs. G. F.,	New Kingstown.
	Garber, S. P.,	Entlerville.
	Cressler, G. E.,	Shippensburg.
	Creamer, J. E.,	Shippensburg.
Dauphin County,	Sober, Miss Martha G.,	Dauphin.
	Meredith, H. C.,	Harrisburg.
	Logan, R. F.,	Steelton.
	Ruof, F.,	Hummelstown.
	Backenstoe, D. C.,	Fort Hunter.
Delaware County,	Hoopes, P. R.,	Wayne.
Erie County,	Shaffer, Ora,	Union City.
	Mixer, W. E.,	Waterford.
	Laurie, C. F.,	Erie.
	Clark, C. W.,	Corry.
Fayette County,	Lange, W. H.,	Belle Vernon.
Franklin County,	Dixon, W. D.,	St. Thomas.
	Rinick, Garnet A.,	Chambersburg.
	De Long, C. A.,	Mont Alto.
	Beatty, T. B.,	Quincy.
Fulton County,	Jackson, R. L.,	McConnellsburg.
	Covalt, Ira,	Covalt.
Hutingdon County,	Lefford, W. C.,	Huntingdon.
Indiana County,	Wehrle, R. W.,	Indiana.
Jefferson County,	Brian, Chas.,	Brockwayville.
	Swab, C. U.,	Brookville.
Juniata County,	Haldman, C. G.,	Thompsontown.
Lancaster County,	Mayer, Dr. I. H.,	Willow St.
	Wister, J. J.,	Columbia.
Lebanon County,	Bohn, J. G.,	Onset.
	Derickson, S. H.,	Annville.
	Strauss, C.,	Fredericksburg.
	Ulrich, A. S.,	Lebanon.
	Mell, J., Jr ,	Richland.
Lehigh County,	Kocher, Dr. J. F.,	Walberts.

PLATE XXXI.—Milk Snake or House Snake (*Lampropeltis doliatus triangulus*). Photo in Nature by Mr. Wm. H. Fisher.

PLATE XXXII.—Spreading Adder or Blowing Viper (*Heterodon platirhinos*). Photographed in Nature by Mr. Wm. H. Fisher.

PLATE XXXIII.—Colored Boy Handling Spreading Adder and Black Snake, showing neither Species is Venomous.
Photographed by the State Zoologist.

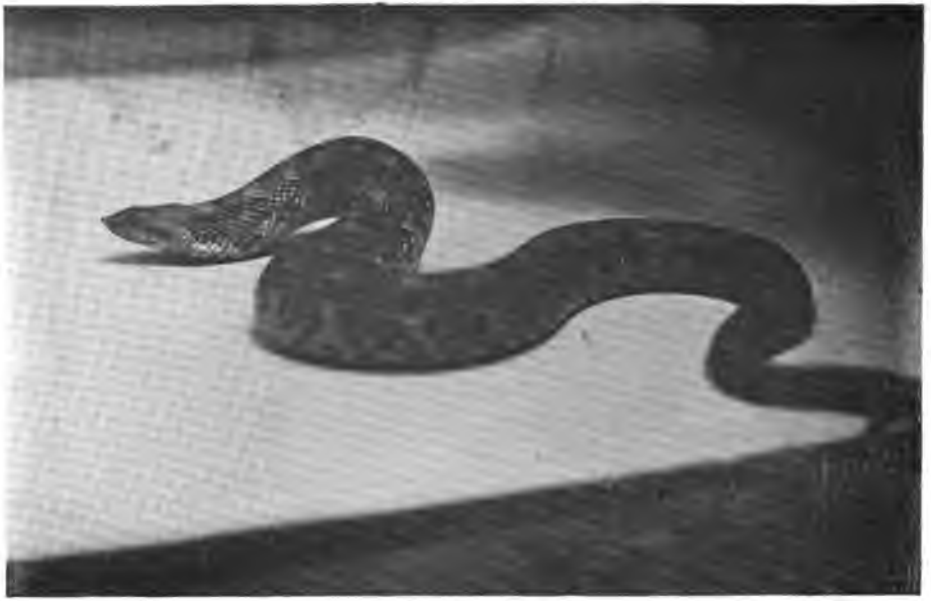


PLATE XXXIV.—Blowing Viper, Spreading Adder or Hog-nosed Adder (*Heterodon platirhinos*).

Photographed while alive and moving, in the Office of the State Zoologist of Pa. Specimen No. 7313.

PLATE XXXV.—Fig. b. Embryos of Hog-nosed Adder or Blowing Viper, just before birth, showing this species is Ovoviviparous. Natural size. Photograph of Pennsylvania Material (No. 3376) in the Office of the State Zoologist.

PLATE XXXVI.—Two Copperhead Snakes (*Agkistrodon contortrix*), in striking position. Photograph of Living Specimens in the Office of the State Zoologist of Pa.

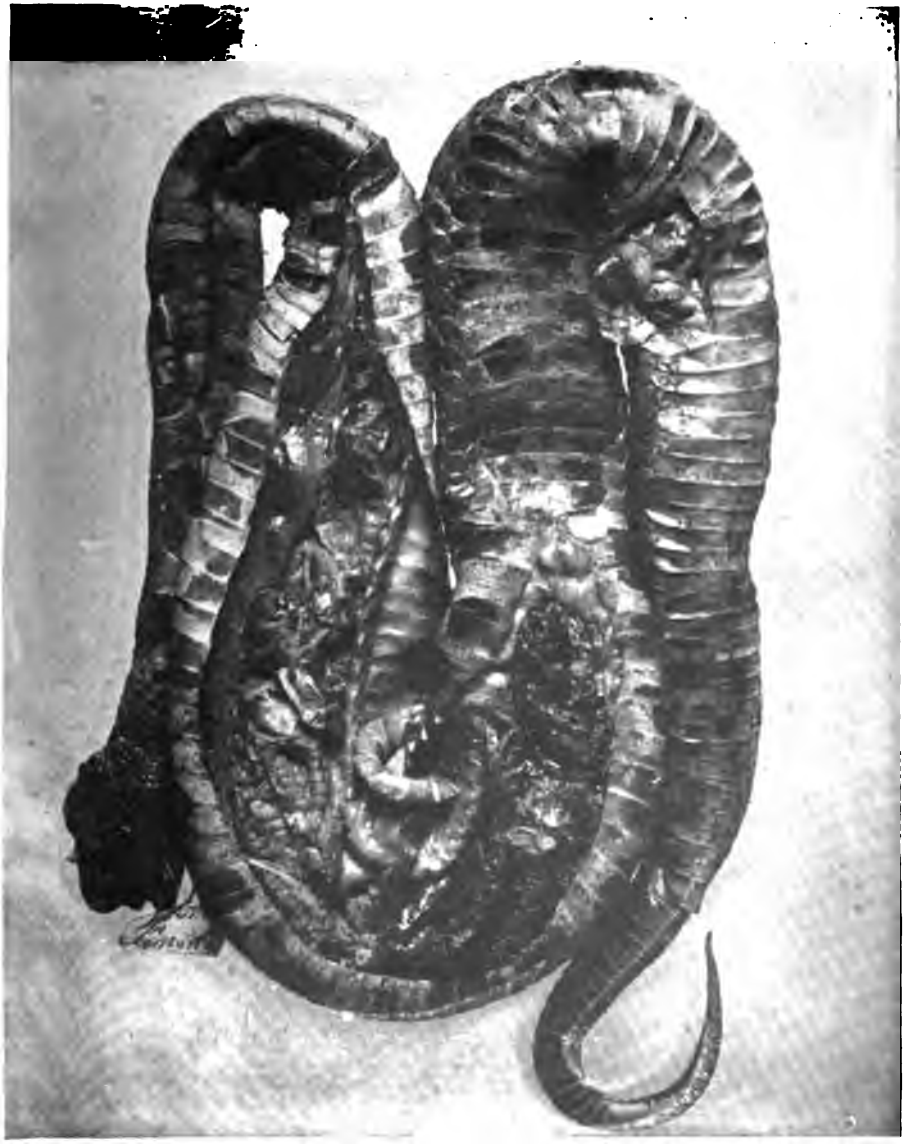


PLATE XXXVII.—Copperhead Snake opened and photographed to show its Stomach filled with Seventeen-year Locusts. Specimen No. 6541b in our Collection, sent by Mr. A. P. White.

PLATE XXXVIII.—Embryos of Copperhead Snakes, before birth, showing that this Species produces living young instead of eggs. Specimen No. 3850a, sent by J. P. Swoope.

Photographed in the Office of the State Zoologist of Pa.

Luzerne County,	Funk, J. B.,	Shickshinny.
	Angus, Wm.,	Stoddartsville.
Lycoming County,	Geddes, J. M.,	Williamsport.
	Shafer, W. E.,	Cogan Station.
Monroe County,	Allegar, I. L.,	Shawnee.
Montgomery County,	Benner, W. M.,	Telford.
	Wagner, Harold,	Pottstown.
Montour County,	Wertman, Mrs. E. G.,	Danville.
Northampton County,	Narne, Dr. F. H.,	Bethlehem.
	Jefferson, J. A.,	Easton.
	Seip, G. W.,	Easton.
Perry County,	Brightbill, Nellie,	Marsh Run.
	Showalter, C. E.,	Landisburg.
Potter County,	Gorham, W. H.,	Coudersport.
	Lehman, J. P.,	Coudersport.
Schuylkill County,	Filbert, B. A.,	Schuylkill.
Snyder County,	Roush, M. L.,	Freeburg.
	Bordner, Dr. H. H.,	Shamokin Dam.
Somerset County,	Suhrie, J. E.,	New Baltimore.
Sullivan County,	Wieland, W. S.,	Nordmont.
Susquehanna County,	Mosher, J. M.,	New Milford.
Tioga County,	Andrews, S. F.,	Wellsboro.
	Mulford, E. R.,	Wellsboro.
	King, K. L.,	Westfield.
	Olver, W.,	Mansfield.
Warren County,	Weld, R. J.,	Sugar Grove.
	Wright, B. G.,	Sugar Grove.
Venango County,	Witherop, C. N.,	Emlenton.
Washington County,	Couch, Jos.,	Canonsburg.
	Couch, Merle,	Canonsburg.
	McCreary,	Crothers.
Wayne County,	Bullock, W. H.,	Honesdale.
Westmoreland County,	Lakin, H.,	Mt. Pleasant.
York County,	Frey, H. S.,	Hellam.
	Hoover, T. B.,	Wellsville.
	May, W. H.,	Wellsville.
	Krone, B. P.,	Lewisberry.

It lives in cultivated districts, and although harmless and entirely innocent, there seems to be much superstitious fear and many ridiculous stories concerning it. The name "House Snake" is given to it because it may be found about the abode of man, which it at times enters. This is mostly caused by cold weather of fall or the lower outside temperature of evening or night cause it to seek a place where the atmosphere is warmer, and thus it may enter the dwelling, but no harm can come from its presence. Most ridiculous stories have been told concerning its milking cows, and it should be enough to say that this is entirely impossible and such stories are without foundation. It is often seen in or near milk houses, and is reported as drinking milk from pans. This may be true, because it is known that many snakes feed upon milk and eggs when they have the opportunity.

The House Snake lays eggs, which vary from seven to twenty in number. These eggs are deposited in loose soil, decaying wood or sawdust. The young are brightly colored and active, and from evidences at hand, this snake is not as strictly nocturnal as are some other species which we have discussed.

Dr. O. P. Hay, in a "Report of the Reptiles and Batrachians of Indiana," published in 1892, said: "According to Dr. Goode's investigations, this snake is oviparous and guards its nest. Whenever danger threatens her young the mother finds an asylum for them down her capacious throat. (See 'American Association for the Advancement of Science,' 1872.) I have taken eggs of this species in Illinois that were buried in a pile of manure and more or less glued together. The egg is two inches long and little less than one and one-fourth inches in diameter. The covering is parchment-like. It contains a young snake ten inches long." We prefer to describe the covering of the egg of the House Snake as leathery, white and opaque, to distinguish it from the thinner parchment-like covering of the egg of the Grass Snake.

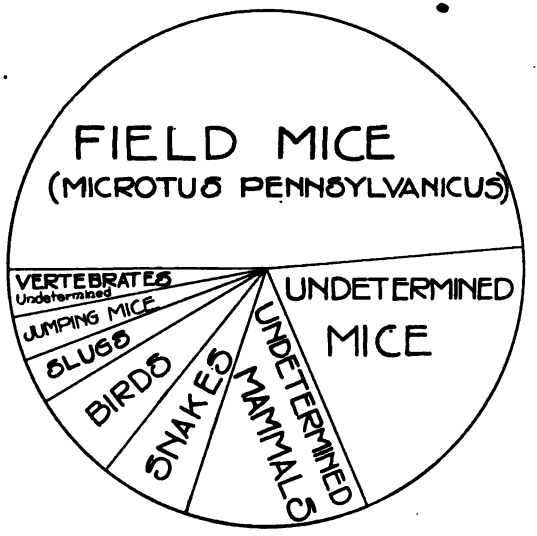


Fig. 17.—Diagram showing the percentages of specimens of Food Items of Milk or House Snake (*Lampropeltis doliatus triangulus*): 48½ per cent. Field Mice (*Microtus pennsylvanicus*); 20 per cent. undetermined Mice; 11 per cent. Unidentified Mammals; 6 per cent. Snakes; 5½ per cent. Birds; 3 per cent. Slugs; 3 per cent. Jumping Mice; 3 per cent. Undetermined Vertebrates.

Our investigations show that the ova commence to develop about the middle of May and become fully developed and are laid about the 10th of August. Our specimen No. 1382 b, collected on that

date, had laid its eggs for the summer. The largest eggs that we found were one and three-fourths inches long and three-fourths in diameter. We have collected them as late as the 25th of October and have evidences that they hatch during that month and September. The young are nearly nine inches long at the time of hatching.

There is very little reported by writers upon the food of this serpent, although Dr. Atkinson has found in its stomach DeKay's Snake, and also the Queen Snake or Striped Water Snake. Cope has also found it feeding upon the Pennsylvania meadow mouse, and Dr. Merriam in "Science News" has reported its eating the Garter Snake.

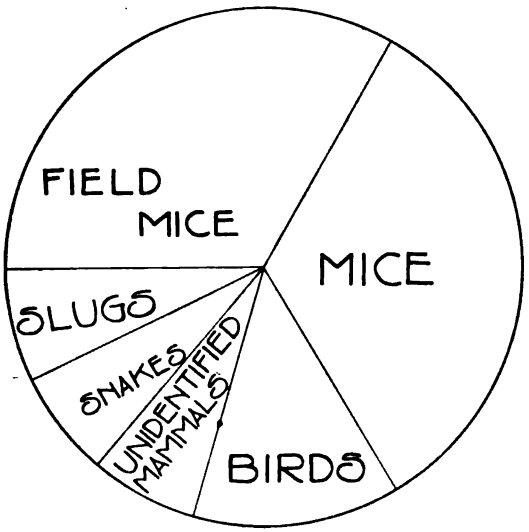


Fig. 17a.—Diagram showing the percentages of Food Items of House Snake (*Lampropeltis doliatus triangulus*) found during July and August only: 33½ per cent. Field Mice; 33½ per cent. Mice; 13 per cent. Birds; 7 per cent. Unidentified Mammals; 7 per cent. Snakes; 6 per cent. Slugs.

In our dissections of ninety specimens we found forty-eight with empty stomachs, and of those which contained food the following table gives the different kinds of animals eaten and the number of specimens of this species feeding upon each kind of material:

No. Specimens:	Food Materials:
1	Slugs.
2	Undet. Vertebrates.
1	Red-bellied Snake.
1	Rock Snake.
1	Undet. Bird.
2	Robin's Eggs.

2	Undet. Mammals.
1	Jumping Mouse.
3	Undet. Mice.
9	Meadow Mice (M. pennsylvanicus).
6	Microtus sp. Mice (uncertain species).
1	White-footed mouse.
1	House mouse.

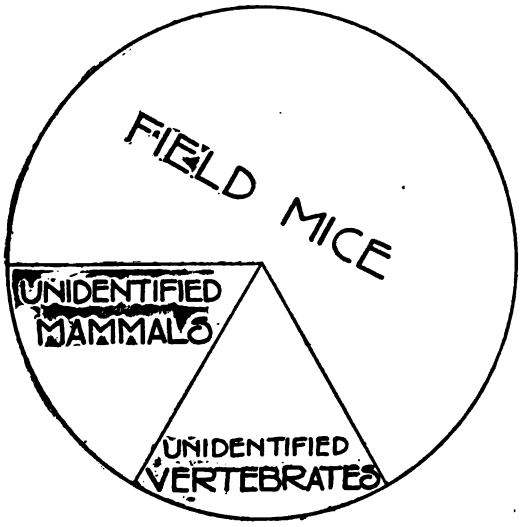


Fig. 17b.—Diagram showing the percentages of Food Items of House Snake (*Lampropeltis doliatus triangulus*) found during September and October only: 67 per cent. Field Mice; 16½ per cent. Unidentified Vertebrates; 16½ per cent. Unidentified Mammals.

When we consider that the above table shows positively that more than half of those individuals which contained food had recently been eating mice of some kind, and that these same mice are among the most destructive creatures of the house, barn, storeroom and farm, we can see sufficient justification for preserving the House Snake or Milk Snake, notwithstanding the unjust superstition, ignorance and fear with which it is regarded.

No. 21. *Heterodon platirhinos* (Latr). Spreading Adder or Blowing Viper. Plates XXXII, XXXIV, XXXV.

This snake is another species of reptile with a great variety of common names. It is variously known as the Spreading Adder, Hissing Viper, Blowing Viper, Blow Viper, Hog-nosed Snake, Blowing Adder, Hissing Adder, Spreading Viper, Hog-nosed Viper, Pilot, Bastard Rattle Snake or Rossel Boshtard and Blaser, and other common names. Most of these names refer to its habit of spreading

its head quite flat when angered and hissing in a threatening manner. There is no more striking example of pure bluff than that which is exhibited by this entirely harmless snake. Not one man in a thousand has the courage to pick up this snake while it is spreading, blowing and striking, but we have seen this done by inexperienced and uninformed persons. We photographed a boy in the act of handling one of these serpents while it was enlarging

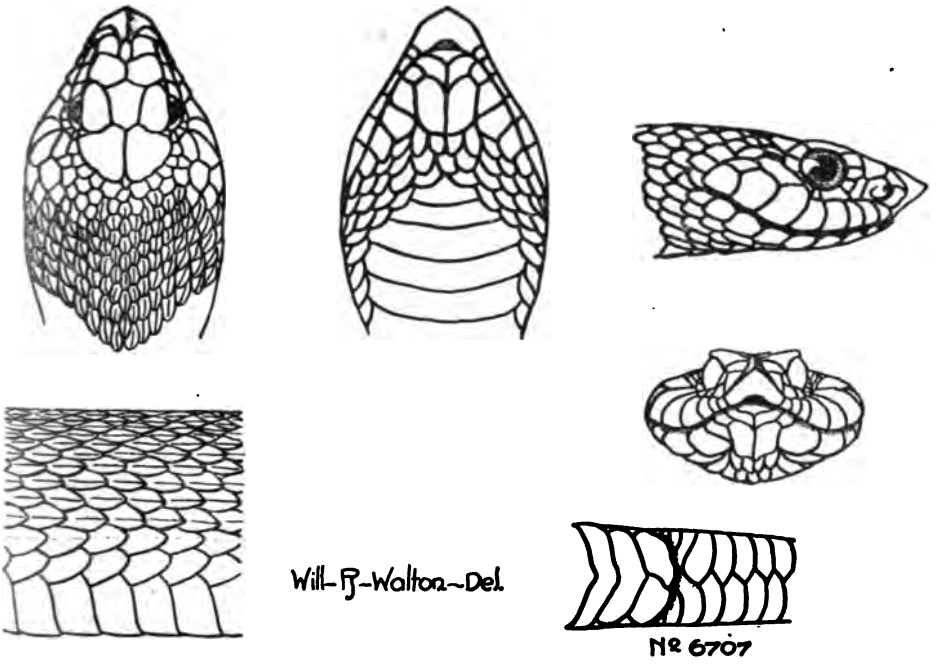


Fig. 18.—Structural Characters of Spreading Adder (*Heterodon platirhinos*). All Natural Size excepting lower right hand figure which is ½ Natural Size. Drawn under supervision of the Economic Zoologist.

and flattening its head. This is shown in Plate XXXIII. The fact that the fear of serpents is not natural but acquired from older persons is shown by the attitude of this little colored boy, James Dean, of Harrisburg, Pa., who at the age of five years came into our office and was very much interested in playing with the living snakes. One day he asked if he could have one, and upon being questioned as to what he would do with it, replied, "I want to take it home." When asked "For what purpose?" he replied, "To get Mam to cook it!"

A very valued and intelligent correspondent in the southeastern part of Pennsylvania wrote to us, endeavoring to call our attention in a kindly manner to a mistake which he thought we had made in

saying that "The Copperhead and Rattler are the only poisonous species of reptiles found in this State." He said, "Surely you have forgotten the Spreading Adder." Nevertheless, we here again repeat the statement that this most threatening snake is entirely harmless, although one of the greatest "bluffers" known in Nature. It must be remembered that it is not unusual for harmless creatures to simulate by color or actions those which have decided means of defense.

The name "Hognosed Adder" is given from the flattened upturned snout or nose, and the specific name *platirhinos* means "flat-nose." This is doubtless used by the serpent in boring into the ground to find a suitable place for bringing forth its young, or passing a dry or cold season. One of the justifications that some people find in considering this species of serpent poisonous is that they say it will strike itself after being teased for some time and fall over dead. Fortunately, we had an opportunity to test the truth of this report. We found one that was molting or casting its outer skin, and the skin over the eyes had loosened enough to make it temporarily blind. After it had been teased for a short time and had thrown itself into a frenzy by spreading, hissing and striking in various directions it struck backwards toward its body but did not hit itself by three or four inches, and at once fell over apparently lifeless. Its mouth was open and dirt could be poked into it without any evidence of sensation on the part of the snake, but one trick showed that it was aware of what was being done to it. It persisted in lying apparently limp and lifeless but upside-down. Every time we would turn it right side up, even though it was simulating death, it would time after time gradually turn back until its back rested upon the ground and the ventral side was up. Perhaps this was an effort on its part to aid its appearance of being dead, and thus induce its tormentor to pass it by as a creature that was *hors de combat*, as do the opossum, curculio, and other forms of animal life practice the same deception. It is needless to say that it had not injured itself and was in its normal condition in less than half an hour.

The genus *Heterodon*, to which belongs the Hog-nosed Snakes, is distinguished by keeled dorsal scales; in twenty-three to twenty-five rows; anal plate bifid and snout recurved and keeled. In fact, the last named feature is enough to distinguish the two species of this genus immediately from all other serpents. The Spreading Adder, which is the one species of the genus found in this State, is described as brownish or reddish, with about twenty-eight dark dorsal blotches besides spots on the sides and half rings on the tail. There is one form (var. *niger*) which is uniformly black, and of

which we collected one specimen in Centre county, Pa., in September, 1900. The length is about thirty inches or less, and the tail is short and thick. In this regard it closely resembles the venomous serpents.

This reptile is found in the eastern part of the United States rather abundantly and no doubt occurs in every county in the State of Pennsylvania. We have received it from the counties named in the list, which is not yet sufficiently complete to justify us in concluding that it does not occur in the northern district, from which we do not have specimens.

Bedford County,	Walls, R. B.,	Saxton.
Berks County,	Leibelsperger, I. H.,	Fleetwood.
Blair County,	Way, A. P.,	Altoona.
Carbon County,	Murphy, H. J.,	Summitt Hill.
Chester County,	Climenson, W. W.,	Honey Brook.
	Gilliford, R. W.,	Spring City.
Cumberland County,	Garver, P. S.,	Entlersville.
Franklin County,	Hoffman, E. D.,	Mercersburg.
	De Long, C. A.,	Mont Alto.
	Myers, J. G.,	Fayetteville.
Huntingdon County,	Black, Joel,	Huntingdon.
	Swoope, J. P.,	Huntingdon.
Luzerne County,	Campbell, E. W.,	Wilkes-Barre.
	Angus, Wm.,	Stoddartsville.
	Truax, S. T.,	Glen Summit Sp'gs.
	Anthony, W. R.,	Glen Lyon.
Monroe County,	Allegar, I. L.,	Shawnee.
	Percho, J.,	E. Stroudsburg.
	Blakeslee, Josephine,	Blakeslee.
	Gould, Mrs. E. V.,	Effort.
Montour County,	West, Mrs. G. P.,	Danville.
Northampton County,	Oxford, T., Jr.,	N. Bangor.
Northumberland County,	Allison, Dr. C. E.,	Elysburg.
Perry County,	Brightbill, H. A.,	Marsh Run.
	Heckendorn, D. K.,	New Bloomfield.
	Couch, F. G.,	Andersonburg.
	Bower, M. R.,	Landisburg.
	Brightbill, H. M.,	Marsh Run.
Union County,	Spigelmeyer, Wm.,	Millmont.
York County,	May, Henry,	Dillsburg.

It lives in dry woods and sandy hillsides, and is often found under bushes by berry pickers, who take unnecessary fright upon seeing it, especially if it is so disturbed as to commence its contortions and hissing.

The Hog-nosed Adder, or Blowing Viper, has been said by many writers to be oviparous or egg-laying, but our specimens do not give us facts to agree with such statements. Our specimen No. 3336, collected August 5th, contained young embryos six and one-half inches in length, each in a very delicate transparent membrane.

These are photographed and reproduced in a plate in this Bulletin, showing decidedly that this reptile is, or at least at times may be ovoviviparous, or bearing living young. The young are borne during the latter part of August or September. During the first week of September we found specimens ten inches in length, which showed the same characters of striking, spreading, blowing, simulating death as have been described in this Bulletin for the adult.

The food of the Hog-nosed Adder reported in literature is as follows: Mice (Morse); birds' eggs (International Encyclopedia); toads and frogs (Morse), and insects (Holbrook). No one has definitely published a statement of their own observations upon the food of this serpent, and consequently little is known about it with certainty.

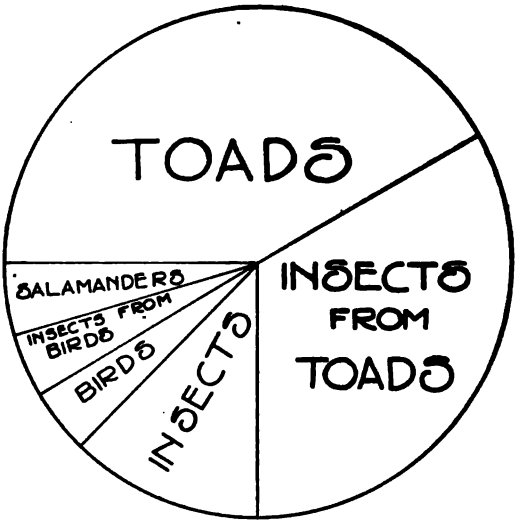


Fig. 19.—Diagram showing the percentages of Food Items of Spreading Adder or Blowing Viper (*Heterodon platirhinos*): 41½ per cent. Toads; 12½ per cent. Insects; 4 per cent. Birds; 33 per cent. Insects from Toads; 4 per cent. Insects from Birds; 4 per cent. Salamanders.

Of the twenty-seven specimens which we have examined we found the following number of individuals with each of the food materials contained in the table below:

No. Specimens:	Food Materials:
6	Undet. Insect fragments.
4	Insects with Toad remains.
1	Insects with Bird remains.
1	Acrididæ (Grasshoppers).
1	Stink-bug.
1	17-year Cicada.
2	Undet. Lepidoptera.

1	Undet. Species Bees.
1	Granite Salamander.
1	Tadpole.
10	Toads.
1	Undet. Bird.

By a study of the above table it will be seen that only one was known to feed upon a bird; none were found with eggs or shells, and none with frogs, although we have several containing insects, one having filled itself with 17-year locusts, and two had eaten caterpillars. However, the most striking fact to be learned by a study of the above table is that the chief element of food of the Spreading Adder is the Common Toad, of which ten specimens had been eaten. This is very unfortunate, because in the wholesale destruction of the toad is found the most serious feature of the life or habits of the Spreading Adder. We fear that the destruction of a few varieties of insects by the Hog-nosed Adder can not atone for the loss of so many toads, and from the economic standpoint this serpent must be considered objectionable because it feeds upon toads, which are known to be decidedly beneficial.

Family 2. *Crotalidæ.* The Rattlesnakes and Copperheads.

The serpents belonging to the Family Crotalidæ are to be recognized by the presence of large poison fangs in the front of the upper jaw and the deep pit on the side of the head, plainly visible between the eye and the nostril. The poison fangs are erectile or so constructed that they lie down when not in use and rise and stand forward when the serpents prepare to strike. No other reptiles have the pit here mentioned and illustrated in Fig. 22. The body is uniformly stout, head flat and triangular, and neck slender. The pupil of the eye is elliptical in shape and stands vertical, as does the pupil of a cat's eye. It dilates or contracts immediately with a decrease or increase of light, respectively. The tail is short and small; the scales are keeled in the Pennsylvanian, the anal plate is entire, and the plates beneath the tail are not divided. This is a family of American reptiles, containing about sixty species, all of which are notorious as being venomous and consequently objectionable. All are ovoviviparous or bring forth living young, and do not kill their prey by constricting it or squeezing it, but by the use of the mouth only.

However, there are only a few in each brood and in this State but one brood per year. There are two species found commonly in this State and a third which is reported from the western part of the State.

The different species of this fortunately small family of venomous serpents may be distinguished at once by the following key:

The Analytic Key to the Family Crotalidæ.

A. With no rattles at end of tail. No. 22. Agkistrodon contortrix (L.). Copperhead Snake. Page 186.

AA. With rattles at end of tail. No. 26.

B. Blotches on back in seven series; rattles small. No. 23. Sistrurus catenatus (Rafin). Prairie Rattle Snake. Page 190.

BB. Blotches on back in three rows, forming zigzag cross-blotches; rattles large. No. 24. Crotalus horridus (L). Common Rattle Snake. Page 191.

No. 22. *Agkistrodon contortrix* (L.). Copperhead Snake. Plates XXXVI, XXXVII, XXXVIII.

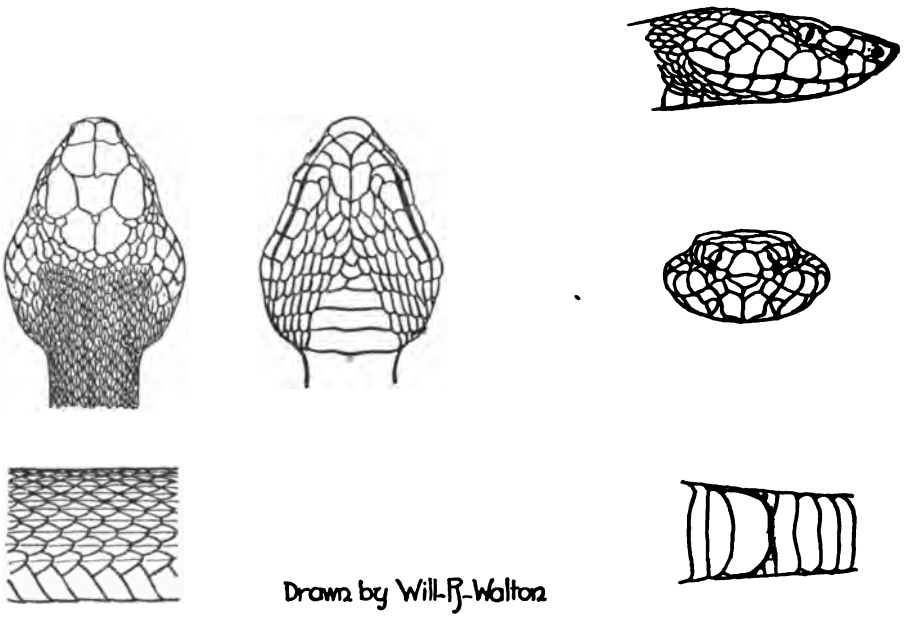


Fig. 20.—Structural Characters of Copperhead Snake (*Agkistrodon contortrix*). Slightly less than Natural Size.

Drawn by the Artist of the Zoologist's Office, under Supervision of H. A. Surface.

The Copperhead Snake has a great variety of common names among which are Cotton-mouth, Hazel-head, Red Viper, Copperbelly, Red Adder, Deaf Adder, Pilot Snake and "Kupper Schlange," in Pennsylvania German. The word "Pilot" should never be applied to this snake, but it is impossible for writers to change a custom that has been so generally established as that of applying this term to the Copperhead Snake in the eastern part of our State, instead of to that form of Black Snake to which it properly belongs.

There is no creature more treacherous, despicable nor dangerous in this State than the Copperhead Snake. It lurks in bushes or grass or among stones, and strikes without warning and often

without provocation. Compared with it, the Rattler is a creature of honor, as the latter strikes only for food or in self defense and it almost always sounds a warning before striking. This gives an opportunity for persons who are on the alert to avoid its venomous attack.

The Copperhead Snake is described as being hazel brown, touched with coppery red; back with a series of fifteen to twenty-five V-shaped blotches; pale yellow, with thirty-five to forty-five dark spots on each side, and the scales arranged in twenty-three rows. The length is about forty inches, or very rarely more.

This dangerous reptile is found from the northeastern part of the United States to Wisconsin and southward, mostly in damp places, although not confined to such localities. Fortunately, it is extinct in most of the cultivated districts of this State which have been long settled, and while it is not decreasing rapidly in the wild mountainous parts of the Commonwealth, its numbers are being reduced until it is not to be found in some counties. We have received it from the counties in Pennsylvania listed below:

Adams County,	Heintzelman, W. E.,	Orrtanna.
Allegheny County,	Johnson, S.,	Pittsburg.
Armstrong County,	Nill, T. W.,	Dayton.
	Allshouse, A. J.,	Leechburg.
Beaver County,	Wright, F. R.,	Smith's Ferry.
	Reed, G. S.,	Baden.
Bedford County,	Kams, Rev. W. E.,	Hopewell.
Berks County,	Griesmer, G. B.,	Spangsville.
Blair County,	Waring, F. R.,	Tyrone.
Carbon County,	Salt, N. E.,	Weissport.
Centre County,	Williams, G. W. R.,	Lemont.
Chester County,	Laurence, Jno.,	Coatesville.
Clarion County,	Kaufman, M. M.,	Clarion.
	Arnold, F. M., Jr.,	Clarion.
Clinton County,	White, A. P.,	Lock Haven.
Cumberland County,	Garber, S. P.,	Carlisle.
Dauphin County,	Haas, R. V.,	Lykens.
	Backenstoe, C.,	Fort Hunter.
Fayette County,	Lange, W. H.,	Belle Vernon.
Franklin County,	Dixon, W. D.,	St. Thomas.
	Hopkins, E. D.,	Mercersburg.
	De Long, C. A.,	Mont Alto.
Fulton County,	Palmer, A. C.,	Warfordsburg.
Huntingdon County,	Gibbs, E. E. C.,	Huntingdon.
	Robb, J. I.,	Alexandria.
	Moyer, S. F.,	Alexandria.
	Lefford, Wm.,	Huntingdon.
Indiana County,	Wehrle, R. W.,	Indiana.
Juniata County,	Yoder, P. C.,	Pleasant View.
	Hoyt, H. J.,	Mifflintown.
Lancaster County,	Penrose, L.,	Drumore.

Lebanon County,	Peiffer, L. S.,	Fredericksburg.
	Derickson, S. H.,	Annville.
Monroe County,	Allegar, I. L.,	N. Water Gap.
Northampton County,	Ashton, Walter,	Easton.
Montour County,	West, Mrs. G. P.,	Danville.
Perry County,	Brightbill, Mrs. Margaret,	Marsh Run.
Warren County,	Wells, R. J.,	Sugar Grove.
Washington County,	Hufford, J. F.,	Amity.
Westmoreland County,	Brinton, G. M.,	Irwin, R. F. D.
Wyoming County,	Smith, H. C.,	Vosburg.
	Welles, R. C.,	Meshoppen.
	Lowe, E.,	Meshoppen.
York County,	Baird, Jno.,	Delta.

Fortunately, it is not a reptile that wanders far from one fixed place of abode, and thus in regions where it does not frequently occur it is not often liable to be found at unexpected moments.

These reptiles often live together and hibernate in dens or retreats that are suitable to them. It is true that great numbers of them are taken at one time from hollow logs, caves or dens.

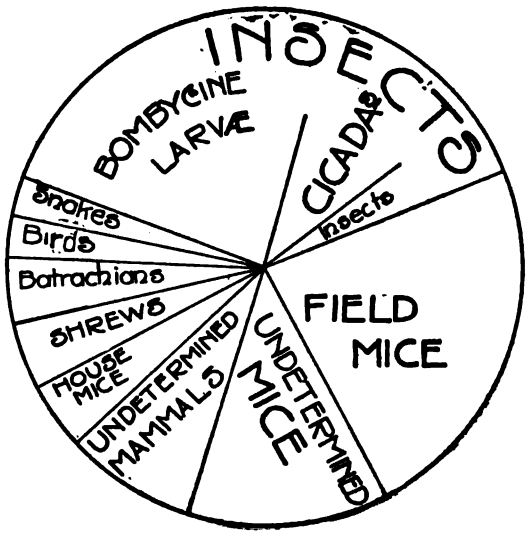


Fig. 21.—Diagram showing the percentages of Food Items of Copperhead Snake (*Agkistrodon contortrix*): 2 per cent. Snakes; 14 per cent. Insects; 8 per cent. Undetermined Mammals; 23 per cent. Bombycine Larvæ; 4½ per cent. Shrews; 4½ per cent. House Mice; 23½ per cent. Field Mice; 13 per cent. Undetermined Mice; 5 per cent. Batrachians; 2 per cent. Birds.

The Copperhead agrees with the other members of this family in being ovoviviparous, or bearing living young. It must be understood as explained in other pages of this bulletin that these are enclosed in a membranous shell but are retained until hatched.

Our dissection shows that in the early part of June these eggs are about one and one-half inch in length on a yolk, with covering, very closely resembling a true egg. Gradually the embryo develops and the yolk is absorbed, and the young is born from the latter part of August to the early part of October. Our specimen No. 2550, collected on the 18th of September, contained eggs one and three-fourths inches in length, with the development of the embryo nearly complete. These could not have been born until October. From six to ten are born at a time. Dr. Atkinson writes "A female kept in the laboratory of the Museum gave birth to six young on the 28th of August, 1900. The young are poisonous at an early age. One of these young eight days old bit the writer on the finger and caused a painful inflammation which continued four days."

This reptile is reported as feeding on frogs and disabled birds, and Dr. Atkinson has found in its stomach the larvæ of insects, cicadas, locusts and small birds. We have found it feeding on the following material:

No. Specimens:	Food Materials:
3	Undet. Insect fragments.
1	Undet. Larvæ.
6	17-year Cicada.
1	Undet. Lepidoptera.
2	Polyphemus moth (larvæ).
2	Io Moth (larvæ).
1	Imperial Moth (larvæ).
1	Regal Moth (larvae).
2	Oak Worms (Anisota sp.)
1	Undet. Vertebrate.
2	Granite Salamanders.
1	House Snake.
1	Sparrow.
3	Undet. Mammals.
3	Oppossums.
3	Undet. Mice.
8	Meadow Mice (M. pennsylvanicus).
5	Meadow Mice (Microtus sp.)
1	White-footed Mouse.
2	House Mice.
1	Undet Squirrels.
1	Undet. Shrews.
1	Mole Shrew (Blarina sp.)

From the above list it will be seen that the food of the Copperhead to a great extent consists of large insects, especially larvæ which fall to the ground from the leaves on which they were feeding, and also of mammals of various kinds, especially the most obnoxious species of mice. Note that six different individuals were found gorged with Seventeen-year Locusts or Cicadas.

From the economic standpoint of its feeding habits in relation to mankind, it is very beneficial, and if it were not for the careless use of a most dangerous weapon we should be justified in recommending its preservation.

No. 23. *Sistrurus catenatus* (Rafin.). **Prairie Rattlesnake. Plate XXXIX.**

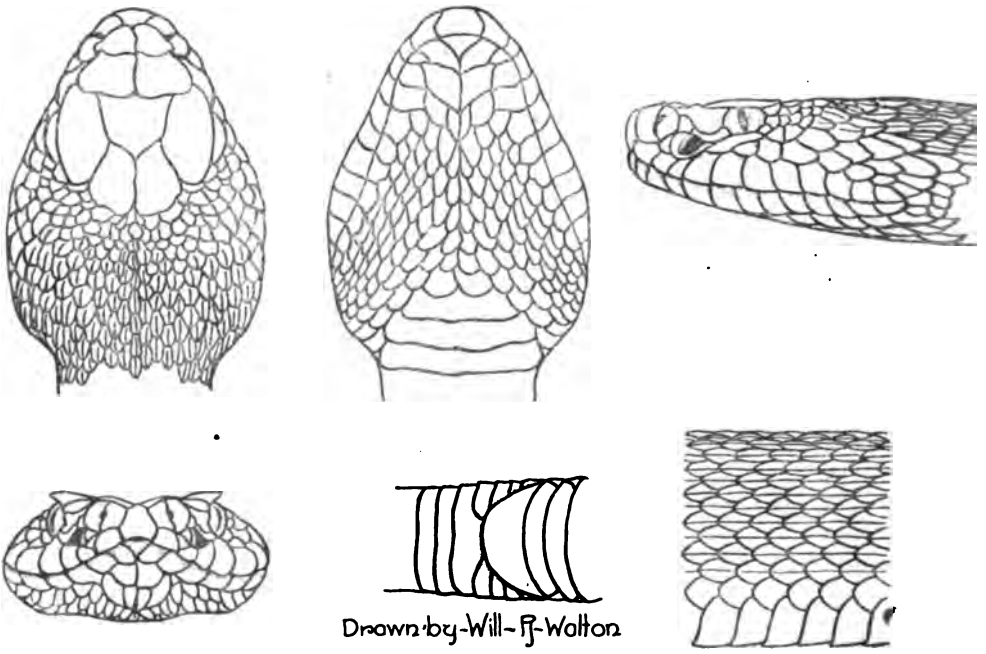


Fig. 22.—Structural Characters of the Prairie Rattlesnake (*Sistrurus catenatus*). Natural size. Drawn in the Office of the Economic Zoologist.

The Prairie Rattlesnake is often called the Massassauga, from the Indian name for this reptile. The name of the genus *Sistrurus*, is from two Greek words, meaning "Rattle-tail;" and the name of the species *catenatus*, is from the Latin, "chained," or "forming a chain," and refers to the color pattern.

It is not usually known that two species of Rattlesnakes are to be found in the State of Pennsylvania, and also that they are described as belonging to different Genera or major groups, although they are of the same family. The Common Rattle Snake, which is generally found in rocky places through the State, belongs to the genus *Crotalus*. The difference between the genera *Sistrurus* (which is the Prairie Rattle Snake) and *Crotalus* (which in-

cludes our Common Rattler) is that the former has the top of the head with about eight plates arranged in a rosette, and the rattle is always very small, while the latter (or *Crotalus*) has the top of the head covered with small scales instead of plates, and the rattle is generally large.

The Prairie Rattler is brown or black, with about seven rows of deep blotches, about thirty-four such blotches in each row, and each blotch with a yellow edge and a blackish shade toward the outside and edged with yellow. From the pit to the neck there is a yellow streak. Occasional specimens may be found which are all black (melanic), as with the Hog-nosed Adder. The ventral plates number one hundred and thirty-five to one hundred and fifty, and the length rarely exceeds thirty inches.

This species of reptile is the one found mostly on the prairies from Ohio to Minnesota and southward, and lives mostly in grassy fields. It is rare in Pennsylvania, being found only in the western part of the State. We have not collected nor seen a specimen from Pennsylvania, although Dr. Atkinson, of the Carnegie Museum, Pittsburg, Pa., published in his "Reptiles of Allegheny County," records of the occurrence of this species. Thus it occurs only in the extreme western part of the State, according to our present knowledge of its distribution in this Commonwealth. There are no published observations on its food or feeding habits, although Dr. Stejneger, in his "Report on the Poisonous Snakes of North America," quotes Dr. Taylor as saying that it feeds on mice and other rodents. No doubt in grassy regions it takes the place of the Common Rattle Snake and its food must be very similar, with due variations for the difference in haunts, as this species lives mostly in grassy fields, while the next is to be found mostly in rocky places. Consequently a variation in food should be expected, with more insects, particularly grasshoppers, taken by this species.

No. 24. *Crotalus horridus* (L.). **Common Rattlesnake. Plates XL, XLI.**

There is no mistaking the Rattle Snakes, as they are the only serpents with horny beads or rattlers on their tails. The noise which they produce is also characteristic, and every person who once hears it will never forget it. It sounds very much like escaping steam or like a mingling of steam escaping and the shrill song of certain species of crickets or locusts. The noise is no doubt made to frighten away intruders and thus preserve the store of venom which may be necessary for saving the life of the serpent on another occasion or for taking its food. This venom is secreted slowly, and after the snake strikes two or three times there is generally not enough left to produce very serious results. Thus it

might be unable to continue to defend itself or capture its prey if it should be so prodigal as to waste its venom. Mankind and nearly all forms of animal life know the sound as well as the odor of this reptile, and have learned to avoid it. It might be asked why the Rattle Snake is blessed with a rattle as a means of protection, while its cousin, the Copperhead, is doomed to go through the world without sounding a similar alarm for driving away intruders, and thus preserving its venom for future needs. This may be explained by observing the difference in the habits of the two species. The Rattle Snake lies quiet, coiled upon a stone, log, rock or hummock, and is often inconspicuous and entirely unseen by the person or creature which it drives away by its sound. It does not generally attempt to flee or crawl from an intruder. The Copperhead remains inactive or attempts to shrink away to a place of safety, until it finds it is discovered, when it will put itself on the defensive. Vigilance and its tendency to retire from danger take the place of the warning rattles. It should be added that in taking their prey the Rattle Snakes do not use their rattles nor fangs, and where the prey is small enough to be captured and eaten without injecting venom into it, they reserve their secretion.

The Common Rattle Snake can be known by its yellowish brown to dark colors of various shades, with three rows of irregular brown spots running together more or less and forming zigzag cross blotches; the tail is black, while the body may vary from almost black to light yellow with spots or blotches. There is a pale line from the mouth to the eye with a very dark patch below it. The ventral plates are one hundred and sixty-five to one hundred and seventy-five in number, and the total length rarely exceeds sixty inches. The largest that we have received or collected is fifty inches long. There is a popular belief in this State that the yellow individuals are females and the black ones are males, but our dissections of all the specimens that we could procure have proven that this is not the truth, but rather that the color is lightest immediately after moulting, and darkest just before moulting, although it appears the yellow is the predominating color of the females and the darker shade prevails among the males.

There is also a popular belief that the age of the snake is to be recognized by the number of rattles and the "button," or small rattle at the tip. Most persons think a rattle is formed each year and consequently a serpent with fourteen rattles and a button should be fifteen years of age. However, this is not true, as we have seen them shed or lose two or three of their rattles at one time in their cages in zoological gardens. Also, we have kept a careful account of the number of rattles in regard to length or

PLATE XXXIX.—Prairie Rattlesnake (*Sistrurus catenatus*).
Photographed by the State Zoologist.

PLATE XL.—Common Rattlesnake (*Crotalus horridus*), dissected and photographed to show a Common Rat (*Mus decumanus*) in its stomach. Specimen No. 3211, sent by John M. Schenck.

PLATE XLI.—Common Rattlesnake (*Crotalus horridus*).
Photographed in Nature by Mr. Wm. H. Fisher.

PLATE XLII.—Common Rattlesnake (*Crotalus horridus*), dissected and photographed to show embryonic young. Showing this Species bears living young instead of laying eggs. Specimen No. 7558, sent by J. C. Williams.

size of the serpent, and find that there is no definite relationship whatever. The rattle itself is only a horny outer-growth of the epidermis or outer skin, and portions of it may be broken off or lost at any time. The vigor with which it is used by its owner is liable to result in its being broken as it hits against some hard object, and although it is true that others are formed from time to time there is no truth in the statement that they are retained by the reptile in such a manner as to definitely indicate age. Of course, an unusually long rattle will be found only on an old individual, but on others of the same age it might be very short. The size of a snake is the most certain indication of its age, although this also varies with the amount of food that it has been able to obtain. As a rule, female snakes are larger than males. This is in accordance with the observed conditions of most species of cold blooded vertebrates.

There is also a popular belief that the Rattle Snake coils itself around regularly, like a rope, and strikes from this coil. This is impossible. Let a person coil a rope and then attempt to uncoil it in the same manner that would be necessary for the snake to follow to strike from such a position, and he will see that it must turn over and over in the uncoiling. While snakes of all kinds do often coil, it shows they never strike from a coil, nor from a stretched out position. In striking they curve the front portion of the body (horizontally n t vertically) somewhat like the letter "S," and their reach in striking is about the distance that this zigzag curve permits them to extend themselves when all the "slack" is played out. There is a popular belief that snakes jump at persons, even for considerable distances. This also is entirely fallacious. No snake is able to strike more than two-thirds or three-fourths of the length of its body. It is impossible for a snake to stand or run on its tail only, and even in its most vigorous attacks the tail is not raised from the ground. The stories of snakes of any kind standing on their tails and chasing men, women and children are untrue, although it must be remembered that, as already said on a previous page of this Bulletin, the Black Snakes will on rare occasions pursue individuals who show their timidity by running from them, and since these snakes are very long they are able to raise their heads, neck and front part of the body from the ground, and by this means can look over the top of the grass through which they are running.

The Common Rattle Snake is found from New England to the Rocky Mountains mostly in rocky places. Its coloration is such that it is generally protected as it lies in the sunshine on the rocks and logs. However common it may be in some portions of this

State it has been so reduced in numbers in our civilized districts as to be practically extinct in some regions. We have received specimens from the counties listed below:

Adams County,	Momson, C. S.,	Bendersville.
	Hoffman, E. H.,	Aspers.
Carbon County,	Salt, N. E.,	Weissport.
Butler County,	McKinley, J. H.,	Harrisville.
Centre County,	Musser, Geo.,	Roland.
Clearfield County,	Brown, G. W.,	Sabula.
Clinton County,	Harvey, O. A.,	Flemington.
Franklin County,	De Long, C. A.,	Mont Alto.
	Shearer, D. M.,	Fayetteville.
Fulton County,	Hess, Jno.,	Dublin Mills.
	Schenck, J. M.,	Enid.
	Jackson, Miss Mabel,	McConnellsburg.
	Millist, A. N.,	Sipes Mills.
Huntingdon County,	Runk, A. J.,	Mt. Union.
Indiana County,	Wehrle, R. W.,	Indiana.
Luzerne County,	Angus, Wm.,	Stoddartsville.
	James, W. T.,	Wilkes-Barre.
Lycoming County,	Shafer, W. F.,	Cogan Station.
	Drill, J. H.,	Cogan Station.
	Dennison, C. E.,	Okome.
	Drill, H.,	Cogan Station.
Monroe County,	Allegar, I. L.,	N. Water Gap.
Northumberland County,	Leitzell, E. A.,	Northumberland.
Perry County,	Brightbill, H. A.,	Marsh Run.
Susquehanna County,	Quinn, J. C.,	Susquehanna.
Tioga County,	Andrews, S. F.,	Wellsboro.
	King, L. K.,	Westfield.
	Howland, Jno.,	Westfield.
Warren County,	Hook, D. B.,	Corydon.
Washington County,	Couch, Jos.,	Hickory.

There are no doubt other counties in which it occurs, and we hope to have specimens from these in time. We should receive more specimens were it not that in some places the oil, skin and hearts are used as quack medicines. There is absolutely no virtue in such a disgusting prescription as a fresh Rattle Snake's heart to be swallowed entire for consumption. It is true that one or two persons have been reported as having been cured by such treatment, but there is no evidence to show that this was the cause of improved health. The skins of Rattle Snakes are sometimes worn by superstitious or credulous persons with an erroneous belief that they cure rheumatism. This useless practice is also adopted with the skin of the eel. The custom no doubt comes from the old idea of *Similia similibus curantur* or "like cures like." The flexibility of the eel's or rattler's skin is no doubt supposed to impart its virtues

to limbs stiffened with rheumatism, even though but a piece of the skin of the eel or Rattle Snake be applied thereto.

The oil of the Rattle Snake finds ready sale among the less settled districts of this State as a sovereign remedy for deafness and various ills of mankind. It is sold at a very high price and may even have a local value of four dollars per pound. However, it is decidedly a "quack" remedy notwithstanding the faith given it by mountaineers and woodmen who when they can not produce it for their own use order it at local drug stores, but in educated communities it finds no sale as it is not used. Reputable physicians never prescribe it any more than they use the skin of the Rattle Snake or eel for rheumatism. There may be some virtue in the penetrating and softening oil for deafness, especially in some cases which are caused by a dryness of the interior of the ear or the hardening of the secretions, but other kinds of oil, such as sweet oil, would serve the same purpose fully as effectually. The use of Rattle Snake oil for deafness again may come from the old theory of like producing like, as the Rattle Snake is supposed to have a keenly developed sense of hearing, the virtues of which are transmitted in the oil. If such doctrines were true we should eat the flesh of ducks if we would swim, the flesh of rabbits if we would run, and of birds if we would fly!

There have been most remarkable stories published concerning the dens of Rattle Snakes and some other species, and while a great many persons have doubted these, we must acknowledge that investigations give facts proving they are true. Rattle Snakes and Copperheads do often live in local spots, such as rocky sides or peaks of mountains, in very great numbers where they continue to congregate and mutiply. At times they will be found in such dens by hundreds, but do not appear to leave them for any great distance, as they generally have holes under the rocks into which they retire at night and for winter hibernation.

Dr. J. T. Rothrock, former State Forestry Commissioner, has just reported to us that Mr. Christian Wagaman, of Fayetteville, Franklin county, Pa., on August 1, 1906, found a den of Rattle Snakes within five miles of Mont Alto, Franklin county, Pa., where he killed one hundred and forty individuals in one day, and the person to whom he related the occurrence went there two days afterward and killed forty, and within a few days Mr. W. returned and killed seventy more. In the northwestern part of Centre county is a similar den, which at this writing is undisturbed. Another den is also reported to us as being situated in Huntingdon county, on the southern peak of the second or third mountain south of Spring Grove Mills (Centre county). We have records of other

snake dens in this State. No doubt readers know of many, and we shall be glad to correspond with them upon the subject.

While most reports record the Rattle Snakes and Copperheads as being nocturnal in their habits, we must regard them more as also diurnal or moving about and feeding in the day time rather than at night. Their food as shown in the table following would likewise indicate this. When it comes time for winter hibernation they go into holes in the ground, crevices in caves or hollow logs and become dormant as do other serpents. Both species of the Rattle Snake and also the Copperhead are ovoviviparous or bring forth living young and bear only a few in a brood, and but one brood per year. There are from nine to twelve in each brood and are generally born in the early part of September. Early in the season the eggs are plainly visible in the female when she is cut open and this gives foundation to the report that the Rattle Snakes lay eggs. It should be remembered that in these eggs are the developing embryo which continue developing until the yolk is absorbed and the very thin membrane which can not be called an egg shell, contains the embryonic Rattler plainly seen within. See Plate XLI.

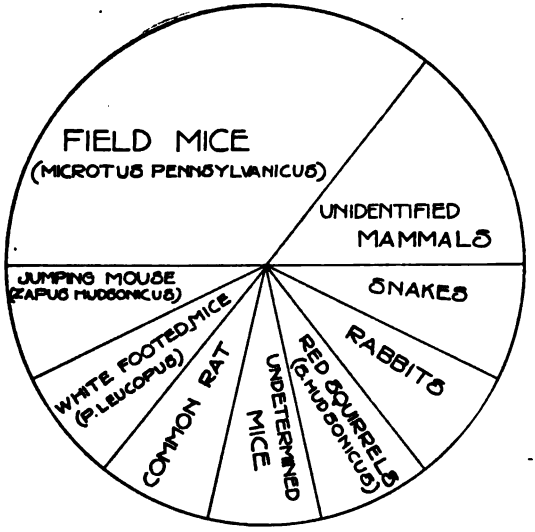


Fig. 23.—Diagram showing the percentages of Food Items of Rattle Snake (*Crotalus horridus*): 37½ per cent. Field Mice; 18½ per cent. Undetermined Mammals; 6 per cent. Snakes; 6 per cent. Rabbits; 6 per cent. Red Squirrels; 6 per cent. Mice; 6 per cent. Common Rats; 7 per cent. Undetermined Mice; 7 per cent. Jumping Mice.

In literature the Rattle Snakes are reported as feeding on rats, mice and rabbits (Holbrook, Morse and Stejneger), and squirrels

and other Batrachians by various authors. Dr. Atkinson has taken a young rabbit from the stomach of one of these serpents.

The following table shows the variety of food of this peculiarly American reptile:

No. Specimens:	Food Materials:
1	Undet. Vertebrate.
3	Undet. Mammals.
1	Rabbit.
1	Jumping Mouse.
6	Meadow Mice.
1	White-footed Mouse.
1	Common Rat.
1	Small Red Squirrel.
1	Undet. Shrew.
1	Common Shrew.

The above table shows that it feeds almost wholly upon mammals or the hairy quadrupeds. As most of these are very obnoxious in their economic relations to mankind, the Rattle Snake, from its feeding habits alone, must be considered one of our important and valuable creatures, as it aids in holding in check the mice and rats that are so destructive to crops of various kinds.

STOMACH CONTENTS OF PENNSYLVANIA SNAKES.

(Report of Specimens Examined on or before June 16, 1906.)

Kind of Species Number.†	4	5	7	8	10	11	12	15	16	18	20	21	23	24
Total No. Examined,	16	21	10	126	11	70	54	22	44	20	90	27	56	20
No. with recognizable food,	5	4	4	73	5	22	29	10	19	6	32	14	41	15
Invertebrata found eaten.														
Branch Annulata.														
Undetermined worms,				1										
Lumbricus sp. (Earth worms),		1		22										
Branch Mollusca.														
Class Gastropoda. (Univalves) Snails and Slugs.														
Stenotrema sp (Snail),				1										
Helix hirsuta. (Snail),								1						
Slugs,	5	3						1			1			
Snails, undetermined,		2		2				1						
Branch Arthropoda (A*).														
Class Crustacea, Cambarus (Crayfish),					4									
Class Arachnida (Spiders),				1				3						
Class Myriapoda (Millipedes),				1										
Class Insecta or Hexapoda (B*).														
Fragments undetermined,			1	8			4	2	3	2		6	3	
Larvæ undetermined,		2					1	2					1	
With Salamander remains,			2											
With Toad remains,				7		2						4		
With Toad remains (probably),				7								2		
With Frog remains,			1						1					
With Bird remains,							4					1		
Order Orthoptera IX (C*).														
Undetermined species,				2		1	1	1						
Fam. 4. Acrididæ. (The Short-horned Grasshoppers),														
Melanoplus femur-rubrum (Red-legged Grasshoppers),				2			2	2	1			1		
Melanoplus bivittatus (Two-striped Grasshoppers),						2								
Fam. 5. Locustidæ (Long-horned Grasshoppers),				1										
Ceuthophilus sp. (Cave Cricket),									2					
Fam. 6. Gryllidæ. Crickets.														
Gryllus pennsylvanicus (Common Cricket),				1				2						
Nemobius fasciatus (Striped Brown Cricket),						1		2						
Order X. Hemiptera (D*).														
Fam. 23. Pentatomidæ (Stink-Bug Family),												1		
Fam. Cicadidæ (Cicadas).														
Tibicen septendecim, (Seventeen year Cicada),												1	6	
Ord. XV. Lepidoptera (Moths and Butterflies).														
Undt. Lepidoptera,				1				2	2			2	1	

Fam. Saturnidæ (Giant Silkworms).														
Samia cecropia (Cecropia Moth),									1					
Telea polyphemus (Polyphemus Moth),													2	
Hyperchiria io (Io Moth),													2	
Fam. Ceratocampidæ.														
Eacles imperialis (Imperial Moth),									2				1	
Citheronia regalis (The Regal Moth),									2				1	
Anisota (Oak Worm),													2	
Fam. Noctuidæ. (The Cutworms),									1					
Fam. Geometridæ. (Measuring Worms),								1						
Ord. XVI. Diptera. Flies.														
Undt. Fly Larvæ,				2										
Ord. XVIII. Coleoptera. Beetles.														
Undt. Beetles,			2	7					2	1				
Fam. Carabidæ. Ground Beetles.														
Undt. Ground Beetles,				3		1			1	1				
Calosoma scrutator (Searcher),				1										
Harpalus. Black Ground Bettle,				1				1						
Fam. Staphylinidæ. Rove Bettles,				1										
Fam. Coccinellidæ. Lady Birds,..				1										
Fam. Lampyridæ. Fire Flies,				2										
Fam. Scarabæidæ,				1										
Euphoria inda. Bumble Flower-Beetle,				1										
Fam. Chrysomelidæ. Leaf-Beetles.														
Donacia sp. Long-horned Leaf Beetles,									1					
Doryphora decemlineata. Colorado Potato Beetle,				3										
Fam. Curculionidæ. Weevils,				1										
Phytonomus punctatus. Clover Leaf Beetle,									2					
Fam. Calandridæ. Bill-Bugs.														
Rhynchophorus sp. Snout Beetles,				1										
Ord. XIX Hymenoptera Wasps, Ants, Bees, etc.														
Undt. sp.,				1										
Fam. Tenthredinidæ. Saw Fly														
Undt. Saw Flies,									1					
Nematus ribesii (?) Currant (?) Worms,									1					
Fam. Ichneumonidæ,									1					
Fam. Formicidæ.														
Black Ants,			2	4										
Red Ants,			1	1				1						
Fam. Apidæ. Bees.														
Undt. sp.,												1		
Vertebrates found Eaten.														
Undt. Vertebrates,				5		2					2		1	1
Class. Pisces. Fishes.														
Undt. Fishes,						6								
Fam. Siluridæ. Catfishes.														
Ameiurus sp. Catfish,						2								
Fam. Catostomidæ. Suckers.														
Catostomus teres. White Sucker,						1								

*A. B. C. D. See The Monthly Bulletin of the Division of Zoology, Vol. 3, No. 9, January 1, 1906, pages, 274, et sep.—H. A. S.

†For names of kinds of serpents indicated by numbers in this chart see lists in previous pages of this Bulletin.

STOMACH CONTENTS OF PENNSYLVANIA SNAKES—Concluded.

Kind of Species Number.†	4	5	7	8	10	11	12	15	16	18	20	21	23	24
Fam. Cottidæ. Star-Gazers.														
Cottus richardsoni. Miller's **Thumb,**						1								
Cottus ictalops. Stone-roller,						1								
Class. Batrachia. Batrachians.														
Undt. Batrachians,				1										
Ord. Urodela. Salamanders.														
Undt. Salamanders,			1			1				1				
Fam. Plethodontidæ. Small-tongued Salamanders,														
Plethodon cinereus. Striped Salamander,			2	1		1		1		1				
Plethodon glutinosus. Granite Salamander,				4								1	2	
Spelerpes bilineatus. Two-striped Salamander,			1											
Fam. Pleurodelidæ.														
Diemyctylus viridescens. Newt. Eft,												1		
Ord. Salientia. Jumping. Batrachians.														
Tadpoles,						1								
Bufonidæ. The Toads,														
Bufo lentiginosus americana. Toad,				17	1	4						10		
Fam. Hylidæ. Tree Toads.														
Hyla versicolor. Great Tree Toad,			1											
Hyla pickeringii. Small Tree Toad,				2										
Fam. Ranidæ. Frogs, Undt. Frogs,				1										
Rana piplens. Leopard Frogs,				2										
Rana sylvatica. Wood Frog,				2			1		1					
Rana clamitans. Green Frog,				1		2			1					
Class. Reptilia. Reptiles.														
Ord. Ophidia. Serpents.														
Fam. Colubridæ. The Constricting Serpents,														
Storeria occiptomaculata. Red-bellied snake,											1			
Storeria dekayi. Rock Snake,											1			
Thamnophis sirtalis. Garter Snake,									2					
Natrix sipedon. Water Snake,									1					
Liopeltis vernalis. Grass Snake,									1					
Lampropeltis doliatus triangulus. House Snake,													1	
Class. Aves. Birds.														
Undt. Birds,							11		1		1	1		
Undt. Eggs,							1							
Chicken Eggs,							1							
Robin Eggs,							1		2					
Fam. Icteridæ. Orioles, etc.														
Agelaius phœniceus. Red-winged Blackbird,							1							

Fam. Fringillidæ. The Sparrows.														
Sparrow sp.,				1			1						1	
Fam. Mniotiltidæ. The Warblers.														
Seiurus aurocapillus. Oven Bird,														1
Fam. Turdidæ. Thrushes.														
Merula migratoria. Robin,							1							
Class. Mammalia. The Mammals.														
Undt. Mammals,						1	4		3		2		3	3
Fam. Didelphididæ. Opossums.														
Didelphis virginiana. Common Opossum,							2							
Fam. Leporidæ. The Rabbits.														
Lepus nuttalli mallurus. Rabbit,									1					1
Fam. Dipodidæ. Jumping Mice.														
Zapus hudsonius. Jumping Mouse,											1			1
Fam. Muridæ. The Mice.														
Undt. Mice,							3		1		3		3	
Microtus pennsylvanicus. Meadow Mouse,						1	3		4		9		8	6
Microtus pennsylvanicus (?) (uncertain sp.),							1		2		6		5	
Peromyscus leucopus. White footed Mouse,											1		1	1
Evotomys, sp. Vole,									1					
Mus musculus. House Mouse,							2				1		2	
Mus decumanus. Common Rat,														1
Fam. Sciuridæ. Squirrels.														
Undt. Squirrels,							1						1	
Sciurus hudsonicus. Small Red Squirrel,							4							1
Tamias striatus. Chipmunk,							1							
Fam. Soricidæ. Shrews.														
Undt. Shrews,							1						1	1
Sorex personatus. Common shrew,						1								1
Blarina sp., Mole Shrew,													1	
Fam. Mustelidæ. The Weasles, etc.														
Putorius sp. Weasles,							2							

Definitions of Terms Used.

Anal, Belonging to the anus or vent.

Anal Plate, The plate just in front of and covering the vent or anus.

Dorsal, Belonging to the Back.

Food Material, Substance intentionally taken as food.

Gonad, Immature reproductive element. In this Bulletin, used to designate the undeveloped young, whether egg or embryo.

Gastrostege, Plates beneath body in front of tail.

Lateral, Belonging to the side.

Ovum, An egg.

Ova, Eggs.

Oviparous, Producing eggs or ova, that mature and are hatched outside the body of the parent.

Ovoviviparous, Bearing living young, which were nourished by a substance like a yolk within a membrane.

Plate, A large, hard, variously-shaped portion of the epidermis which lies against the edge of its neighbor rather than overlapping.

Poison, A substance producing a noxious effect upon the system, but not an animal secretion.

Scale, The smaller pointed portion of the epidermis which overlaps its neighbors and is partially covered by another.

Stomach Contents, Referring in this Bulletin to any contents of the digestive tract.

Urostege, A plate beneath the tail.

Venom, A noxious secretion from poison glands of animals.

Ventral, Belonging to the lower or ventral side, or beneath.

Viviparous, Bearing living young, which were nourished by direct connection with the circulatory system of the parent.

SPECIMENS RECEIVED DURING JUNE, 1906.

We are indebted to contributors named below for the following list of specimens received during the month of June, which does not include the collections made by the employes of this office:

Number.	Specimen—Insects.	Date—June, 1906.	Name and Address.
6416	Beetles,	1	H. J. O'Conner, Harrisburg.
6417	Luna Moth,	2	J. H. L. Rowley, Emlenton.
6422	Butterfly (L. arthemis),	4	H. J. Smith, Fryburg.
6423	Eyed Elater,	4	H. A. Rice, Landisburg.
6424	Long-horned Beetle,	4	Mrs. J. Pophan, Ringtown.
6425	Moth Larva,	4	E. E. Erdman, Shamokin.
6428	Work of Plum Curculio,	4	D. M. Wertz, Quincy.
6429	(a) San José Scale, (b) Surfy Scale,	4	C. M. Brodhead, Old Forge.
6431	Plant Lice,	4	E. B. Callaway, Honesdale.
6432	Cecidomyia Galls,	4	G. Hiester, Harrisburg.
6433	(a) Plant Lice,	4	J. F. Warg, Hawley.
6435	Caddis Flies,	4	W. H. Wolff, State College.
6437	Butterfly,	4	I. Bolinger, Dublin Mills.
6438	Oyster-shell Scale,	4	L. Walter, Klahr.
6447	Giant Water Bug (B. griseus),	4	J. N. McIntire, Sandy Lake.
6449	17-year Cicada,	5	W. R. Gorman, Hartley Hall.
6450	17-year Cicada,	5	W. F. Meredith, Stouchsburg.
6451	(a) Thalessa atra, (b) Thalessa nortonii, (c) Hymenoptera,	5	W. F. Fink, Osceola Mills.
6453	Vanessa Larvæ,	5	R. M. Blatt, Huntingdon.
6454	(a) Lecanium on Maple, (b) Oyster-shell Scale,	5	Dr. W. S. Ruthrauff, Mountaindale.
6455	(a) Syrphid Pupa, (b) Cynip Gall,	5	Miss C. Ott, Buckingham.
6456	(a) Tiger Beetle (C. 6-guttatus), (b) June Beetle, (c) Horned Passalus,	5	M. S. Rhodes, Newtonburg.
6460	(a) Plant Lice, (b) Jassids,	5	J. A. Farrabaugh, Bradley Junction.
6461	Long-horn Beetle,	5	D. L. Keister, Harrisburg.
6462	Cottony Maple Scale,	5	H. M. Morris, Homestead.
6465	Plant Lice,	5	A. H. Sinsabaugh, Wyalusing.
6466	Plant Lice,	5	C. W. Leitzell, Northumberland.
6469	Oyster-shell Scale,	5	G. L. Taylor, Perulack.
6470	Cloak Knotty Horn,	5	J. Meloney, Imperial.
6472	Flat-head Apple Borer,	5	J. C. Stratton, Strattonville.
6478	(a) Plant Lice, (b) Grasshoppers, (d) Wire Worm, (e) Arctiid (H. tessellaris),	6	W. H. Bullock, Honesdale.
6479	Bee,	6	G. M. Gates, Girard, Ill.
6480	(a) Plant Lice, (b) Moth Eggs, (c) Work of Jassids,	6	G. H. B. Terry, Wyalusing.
6481	Plant Lice,	6	J. W. Hampton, Charmian.
6482	(a) Plant Lice, (b) Lightning Beetles,	6	A. B. Callihan, Helen Furnace.
6484	Leaf Beetles,	6	D. Keirn, Hastings.
6486	Insects,	6	H. Schick, Harrisburg.
6487	Locust-boring Moth,	6	C. Anderson, Harrisburg.
6490	Oyster-shell Scale,	6	Mr. Willis, Harrisburg.
6492	Plant Lice,	6	F. S. Snayberger, Molino.
6494	Plant Lice,	7	W. E. Musser, New Bethlehem.
6495	(a) Eyed Elater, (b) Cecropria,	7	J. G. Care, Irvona.
6497	(a) Ground Beetle (C. Scrutator), (b) Warble Fly Larva,	7	Miss E. C. Cox, Buckingham.
6498	Plant Lice,	7	Mrs. M. Davis, Norristown.

Specimens Received During June—Continued.

Number.	Specimen—Insects.	Date—June, 1906.	Name and Address.
6501	(a) Oyster-shell Scale, ...	7	M. L. Line, Wilkes-Barre.
	(b) San José Scale, ...		
	(c) Leaf Beetle (G. rufosanguinea),		
6502	Rose Chafer, ...	7	E. S. Rhinehart, Mercersburg.
6503	Vonessa Larvæ, ...	7	Mrs. J. W. Atkinson, Buckingham.
6507	Lecanium, ...	8	A. H. Clark, Muncy.
6511	Tree Cricket, Egg punctures, ...	8	F. A. Moore, Reynoldsville.
6512	Bag Worms, ...	8	H. H. Grimm, Middleburg.
6513	Dermestid Larvæ, ...	8	S. R. Nissley, Manheim.
6514	Rose Chafers, ...	8	J. S. Keipp, W. Alexander.
6515	Burying Beetle, ...	8	H. Erway, Wellsboro.
6516	Diptera Larvæ, ...	8	F. Segling, Eldred.
6519	(a) Lecanium, ...		
	(b) Aphids, ...	8	S. L. Brinton, W. Chester.
6521	Dragon Fly (E. heros), ...	8	G. Plummer, Harrisburg.
6528	Tortoise Beetle, ...	9	Mrs. E. Robinson, Phila.
6532	(a) Apple Tent-caterpillars, ...		
	(b) Misc. Insects, ...	9	J. R. McMillan, Gettysburg.
6535	(a) Aphids, ...		
	(b) Syrphid Larvæ, ...	11	I. T. Hann, W. Middlesex.
6536	Chalcid Pupæ, ...	11	A. B. Gensler, Allen.
6537	(a) Beetle (M. heros), ...	11	D. W. Navle, Wellsboro.
6538	Cloaked Knotty Horn, ...	11	H. S. Webb, Scranton.
6539	(a) Lecanium, ...		
	(b) Mealy Bug, ...	11	E. R. Musser, Grant.
6542	(a) Cecropia, ...		
	(b) Luna, ...	11	J. C. Franke, Coudersport.
6543	(a) Lightning Beetle, ...		
	(b) Plant Lice, ...	11	J. S. Wanick, Montrose.
6544	Rose Chafers, ...	11	J. Schall, Spring City.
6545	Seventeen Year Cicada, ...	11	U. R. McCartney, Altoona.
6547	Larder Beetles (B. lardarius), ...	11	A. B. Grubb, Annville.
6548	Sialidæ, ...	11	L. M. Raver, Fleetville.
6551	Seventeen-year Cicadas, ...	11	J. E. Patterson, Glen Summit Spring.
6552	Moth Larvæ, ...	11	E. E. Erdman, Shamokin.
6553	Cottony Maple Scale, ...	11	N. McClintock, Pittsburg.
6555	(a) Thalessa atra, ...		
	(b) Thalessa lunator, ...	11	R. Kisner, Danville.
	(c) Bark showng punctures, ...		
6556	Elm Coxcomb Galls, ...	11	J. G. Krichbaum, Chambersburg.
6557	(a) Plant Lice, ...		
	(b) Vanessa larvæ, ...	11	W. Codney, Wellsboro.
6558	Bean Weevil (B. obtectus), ...	11	J. D. Gill, Sr., Philipsburg.
6559	Lemon Lecanium, ...	11	E. E. Beck, Huntingdon.
6561	Insects, ...	11	C. Anderson, Harrisburg.
6565	Rose Chafers, ...	12	R. S. Rebert, Hanover.
6566	Plant Lice, ...	12	W. Batty, Lenni Mills.
6567	Thalessa lunator, ...	12	J. T. Blake, Fox Chase.
6568	(a) Morning Cloak Larvæ, ...		
	(b) Arcaid (H. caryæ), ...	12	W. H. Bullock, Honesdale.
6571	(a) Scurfy Scale, ...		
	(b) Pentatomid Eggs, ...	12	J. M. McEwen, Mercer.
6573	Cecropia Moth, ...	12	A. L. McHenry, Harrisburg.
6580	(a) Giant Water Bug (B. amer.), ..		
	(b) Dragon Fly (E. heros), ...		
	(c) Swallow-tail (P. turnus), ...	13	F. S. Andrews, Wellsboro.
	(d) Io Moth, ...		
6581	Thalessa atra, ...	13	L. D. Goodspeed, Wellsboro.
6582	Lecanium on Peach, ...	13	J. K. Bomberger, Bismarck.
6583	Ground Beetle (C. scrutator), ...	13	H. J. L. Rowley, Emlenton.
6584	Rose Chafers, ...	13	S. Schlegel, E. Salem.
6585	Carpet Beetles, ...	13	J. H. Cogswell, Titusville.
6586	Luna Moth, ...	13	Mrs. C. J. Barney, Warren.
6588	Leaf Beetle (G. rufosanguinea), ...	13	J. Fielding, Scranton.
6589	Rose Chafer, ...	13	H. K. Miller, Huntsdale.
6590	Rose Chafers, ...	13	K. Kelly, Dillinger.
6591	Long-horned Beetle Larvæ, ...	13	G. T. Satterthwait, Ercildoun.
6594	(a) Caddis Fly, ...		
	(b) Sphinx (P. Pandora), ...	13	H. J. O'Conner, Harrisburg.
6595	(b) Yellow Swallow-tail		
	(c) Black Swallow-tail, ...		
	(d) Luna Moth, ...	13	Mrs. M. C. Brightbill, Marsh Run
	(e) Butterfly (A. cybele), ...		
6600	Rose Chafers, ...	14	S. S. Kane, Alinda.
6601	Oyster-shell Scale, ...	14	J. F. Conrad, Lindsay.
6602	(a) Morning Cloak Butterfly, ...		
	(b) Larvæ Cloak Butterfly, ...	14	D. Spencer, Williamsport.
	(c) Lecanium, ...		

Specimens Received During June—Continued.

Number.	Specimen—Insects.	Date—June, 1906.	Name and Address.
6603	Ground Beetle (C. scrutator),	14	J. J. Hoffman, Reynoldsville.
6604	Luna Moth,	14	Mrs. C. J. Barney, Warren.
6605	Corn Root Webworm,	14	B. A. McQueen, Millers Station.
6606	Gortyna Larva,	14	D. W. Bowman, Montoursville.
6607	(a) Morning Cloak Larva, (b) Leaf Beetles (L. scripta),	14	Dr. S. Wood, McDonald.
6608	(a) Io Moth, (b) Long-horn Beetle (S. vestita), (c) Undt. Beetle,	14	E. Blinzler, Emporium.
6610	Beetle Larva,	14	H. C. Heilman, Montgomery.
6612	(a) Dragon Fly (E. heros), (b) Misc. Insects,	14	J. S. Kelly, Highspire.
6613	Psocids,	14	Mrs. S. S. Hostetter, Lancaster.
6614	Rose Chafers,	15	D. M. Wertz, Quincy.
6615	Wooly Aphis,	15	J. J. Black, Gettysburg.
6616	Rose Chafer,	15	M. M. Plank, Joanna.
6617	Spittle Insects,	15	W. H. Moon Co., Morrisville.
6620	Underwing Larva (Catocala),	15	H. S. Buck, Clearfield.
6622	Rose Chafers,	15	H. C. Myers, Jersey Shore.
6623	Gortyna Larva,	15	F. Anderson, Geneva.
6624	San José Scale,	15	P. M. Stiely, Rough-and-Ready.
6625	Rose Chafers,	15	B. F. Reider, Kutztown.
6632	Stone Fly,	15	J. M. Crull, Landisburg.
6633	(a) Thalessa atra, (b) Ichneumon,	16	W. S. Fink, Osceola Mills.
9634	(a) Cottony Maple Scale, (b) Plant Lice, (c) Mourning Cloak Larvæ, (d) Silk Moth Larvæ,	16	W. H. Bullock, Honesdale.
9635	(a) San José Scale, (b) Scurfy Scale,	16	W. K. Warden, Oxford.
6637	Pentatomid Eggs,	16	D. K. Sterrett, Oakville.
6639	Gortyna Larvæ (P. nitela),	16	J. M. March, Spring City.
6640	Long Horned Beetles,	16	R. J. Weld, Sugar Grove.
6641	Rose Chafers,	16	P. S. Fenstermaker, Allentown.
6642	Leaf-cutting Bee Larvæ,	16	R. G. Brooke, Schwenksville.
6643	Lecanium,	16	Mrs. W. George, Warren.
6644	Dragon Flies,	16	C. Anderson, Harrisburg.
6646	San José Scale,	16	B. O. Smith, Burlington.
6648	Leaf Beetle (G. rufosanguinea),	18	H. A. Brinkman, Lehighton.
6649	Five-spotted Sphinx,	18	M. M. Kendall, McConnellsburg.
6651	(a) Luna Moth, (b) Rose Chafers, (c) Flower Beetle, (d) Caddis Fly Case,	18	Mrs. G. P. West, Danville.
6655	Plant Louse Galls,	18	H. A. Smith, Sunbury.
6656	Oyster-shell Scale,	18	W. H. Hickok, Troy.
6658	(a) Cottony Maple Scale, (b) Chalcid,	18	A. Koenig, Harrisburg.
6659	Insects,	18	H. J. O'Conner, Harrisburg.
6660	Beetles,	18	M. Jacobs, Harrisburg.
6664	(a) Luna Moth,	20	J. E. Patterson, Glen Summit Springs
6665	Cottony Maple Scale,	20	Warren J. Ellis, Phila.
6666	Cottony Maple Scale,	20	S. J. Barnett, Delta.
6668	San José Scale,	20	M. O. Reagle, Mount Bethel.
6669	Seventeen-year Cicadas,	20	W. Jones, Old Forge.
6670	Rose Chafers,	20	J. Willebran, Cresson.
6671	Corn Root Webworm,	20	L. D. Sanders, Centerville.
6672	San José Scale,	20	F. Keith, Eagle Foundry.
6673	Buprestid Beetle,	20	A. W. Young, Manheim.
6674	Maple Phylloxera,	20	O. L. Benton, Titusville.
6675	Oyster-shell Scale,	20	Miss L. Moore, Edgeworth.
6678	Rose Chafers,	21	S. M. Robinson, McConnellsburg.
6679	Mourning Cloak Larvæ,	21	W. H. Bullock, Honesdale.
6680	San José Scale,	21	T. P. Meyer, Lock Haven.
6682	(b) Capsid Plant Bug,	21	Mrs. J. W. Atkinson, Buckinghan
6683	Rose Chafers,	21	W. S. Huey, Allensville.
6684	(a) Wolly Aphis, (b) Lecanium,	21	J. Vallerchamp, Jr., Halifax.
6685	Helgamite Dobson Fly,	21	A. W. Clancy, Glenwood.
6687	Milk Weed Butterfly Pupa,	21	H. Illig, Richland.
6688	Corn Root Webworm,	21	H. S. Lauback, Springtown.
6689	Larva of Papaipema nitela,	21	H. Compton, McClane.
6690	Anthrenus Larvæ,	21	A. D. Wentz, Spring Forge.
6691	(d) Seventeen-year Cicada,	21	C. Casner, Williamsport.
6693	(a) Oyster-shell Scale, (b) Lecanium,	21	J. O. Brookbank, Driftwood.
6694	Oyster-shell Scale,	21	Brookbank Mercantile Co., Driftwood.

Specimens Received During June—Continued.

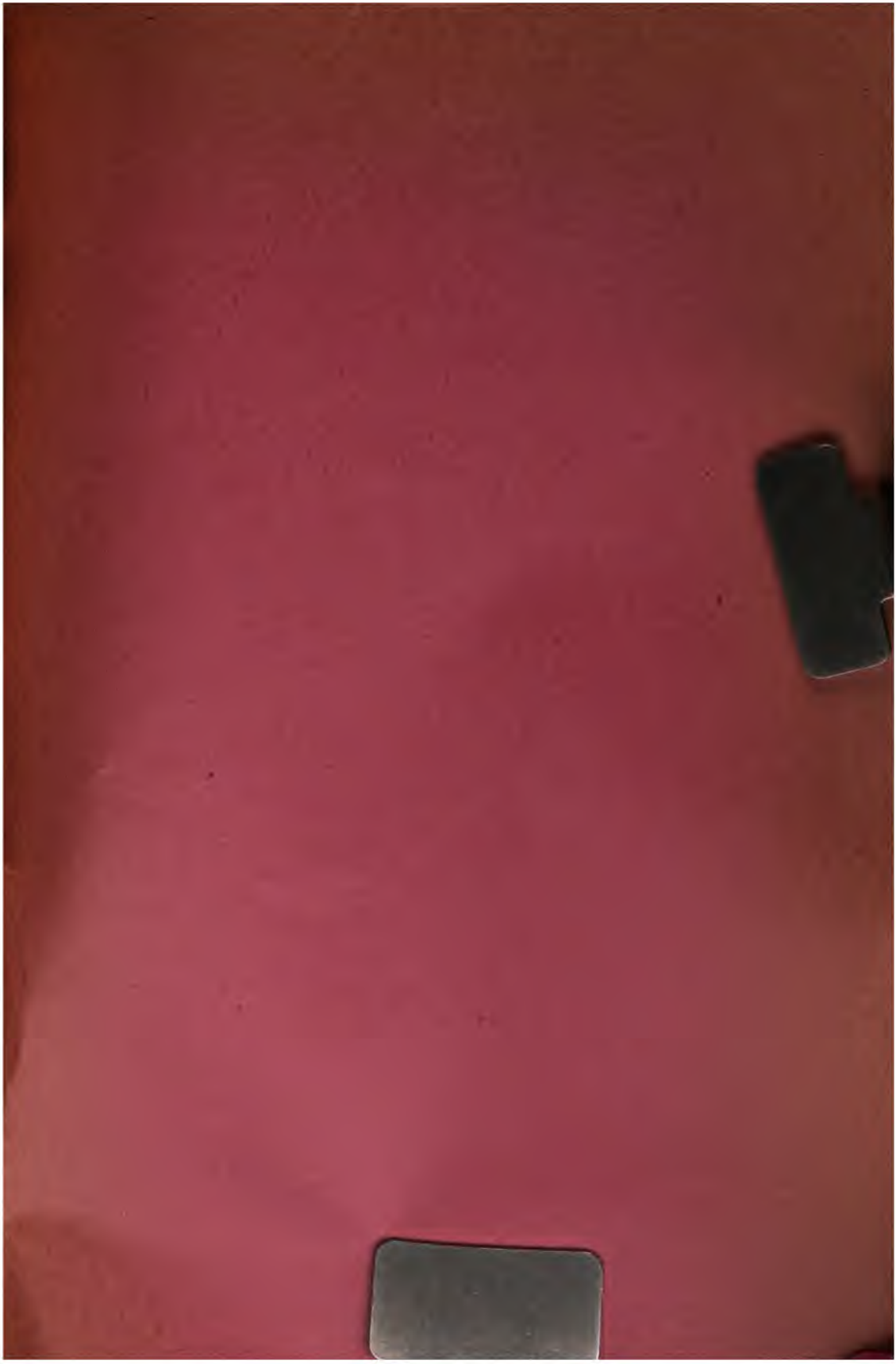
Number.	Specimen—Insects.	Date—June, 1906.	Name and Address.
6700	Cottony Maple Scale,	22	J. M. Witman, St. Mary's.
6702	Lecanium,	22	A. McCall, Union Church.
6706	Rose Chafers,	22	Geo. L. Enhart, St. Thomas.
6710	Dragon Flies,	22	Chas. Anderson, Harrisburg.
6713	Tree Hopper,	23	J. A. Fackler, Linglestown.
6715	Larvæ of P. nitela,	23	J. W. Gihnor, Enon Valley.
6716	Corn Silvanus (S. surinamensis),	23	J. H. Christy, Penfield.
6720	Seventeen-year Cicada,	25	C. Cassner, Williamsport.
6722	Eyed Elater,	25	W. H. Taplin, Holmesburg.
6726	Work of Papaipema,	25	E. S. Bayard, Pittsburg.
6727	Cherry Leaf Folder (C. cerasivorana	25	W. H. Bullock, Honesdale.
6729	Diptera Larva,	25	J. Swift, Phillipsburg.
6731	(b) Wooly Aphis,		
	(c) Ants,	25	H. A. Brightbill, Marsh Run.
6732	Cecidomyia (?) Galls,	25	C. P. Dadant, Hamilton, Ill.
6733	Work of Plum Curculio,	26	D. M. Wertz, Quincy.
6737	(a) Io Moth,		
	(b) Beetles,	26	H. Schick, Harrisburg.
	(c) Diptera,		
6738	Insects,	25	H. J. O'Conner, Harrisburg.
6740	Parasitized Plant Lice,	25	Holmes Seed Co., Harrisburg.
6742	Maple Pseudococcus,	25	B. F. Barr, Lancaster.
6743	(a) Bumble Flower Beetle (E. fulgida),		
	(b) Long-horned Beetle,	25	S. Still, Fisher's Ferry.
	(c) Buprestid Beetle,		
	(d) Pentatomid,		
6744	Catocola Larva,	25	F. C. Byers, Richland Furnace.
6745	(a) Beet (?) Leaf Miner,	25	J. E. Bird, Dushore.
6748	Seventeen-year Cicadas,	26	F. R. Waring, Tyrone.
6749	Long-horned Beetles,	26	R. J. Weld, Sugar Grove.
6754	Cherry Leaf Miners,	26	H. C. McKenrick, Clearfield.
6757	Eyed Elater,	27	C. J. Stratton, Erie.
6760	(a) Lecanium,	27	L. Moore, Brownsville.
6761	Gossyparia spuria,	27	J. C. Withrow, Vanport.
6764	(a) Gossyparia spuria,		
	(b) Cicada Punctures,		
	(c) San José Scale,	28	J. Fielding, Scranton.
	(d) Oyster-shell Scale,		
6768	Wooly Aphis,	28	J. R. Rodgers, Carlisle.
6769	Aphis Galls,	28	C. Yoder, Pleasant View.
6770	Rose Chafers,	28	J. J. Bauman, Bradley Junction.
6772	(a) Maple Borer (P. speciocus),		
	(b) Leaf Chafer (A. lucicola),	28	Mr. Myers, Hughesville.
6773	Syrphid Fly,	28	Mrs. H. A. Surface, Camp Hill.
6776	Giant Water Bug (B. griseus),	28	H. Barrington, Harrisburg.
6779	Maple Phylloxera,	28	J. F. Lewis, Phila.
6780	Plant Lice,	28	Rummel, Himes & Co., Shippensburg.
6781	Cabbage Moth Larvæ (M. picta),	28	A. B. Moore, Reynoldsville.
6782	P. nitela,	28	F. E. Talley, Brandywine Summit.
6784	San José Scale,	28	H. Harris, Aldan.
6785	San José Scale,	28	E. Newhart, Stroudsburg.
6790	Fly Larva,	29	J. Swift, Phillipsburg.
6791	(d) Grasshoppers,		
	(e) Butterfly arthemis,	29	W. H. Bullock, Honesdale.
6792	Aphis Galls,	29	G. M. Brinton, Irwin.
6795	Morning Cloak Larvæ,	29	C. L. Peck, Coudersport.
6796	(a) Scurfy Scale,		
	(b) Cicada Wing,	29	G. A. Stanton, Hollisterville.
6797	Cecidomyia Galls,	29	H. Schick, Harrisburg.
6804	(b) Oyster-shell Scale,	30	G. A. Rice, Coryville.
6806	Parasitized Lecanium,	30	A. McCall, Union Church.
6807	(a) Elm Coxcomb Galls,	30	R. W. Wehrle, Indiana.
6808	(a) Powder Post Beetle,		
	(b) Clerid Beetle,		
	(c) Long-horned Beetle,	30	Hickock Mfg. Co., Harrisburg.
	(d) Braconidæ,		
6809	(a) Wooly Aphis,	30	Geo. R. Ross, Lebanon.
	(b) Moth,		
	Invertebrates, not Insects.		
6433	Red Mites,	4	F. J. F. Ward, Hawley.
6441	Slugs,	4	Minnie L. Benton, Titusville.
6456	(d) Black Spider,	5	M. S. Rhodes, Newtonburg.
6478	(c) Centipedes,	6	W. H. Bullock, Honesdale.
6537	(b) Millipede,	11	D. W. Navle, Wellsboro.
6579	Spider,	13	W. J. Burns, Reedsville.
6644	(b) Centipede,	20	J. E. Patterson, Glen Summit Springs.

Specimens Received During June—Continued.

Number.	Specimen—Insects.	Date—June, 1906.	Name and Address.
6680	(b) Mites,	21	T. P. Meyer, Lock Haven.
6717	Nematodes,	23	Mrs. J. Spencer, Towanda.
6745	(b) Red Mites,	25	J. E. Bird, Dushore.
	Reptiles and Batrachians.		
6427	Ring-necked Snake (D. punctatus),	4	L. H. Hawthorne, New Castle.
6436	Pilot Snake (C. obseletus),	4	R. A. Stewart, Independence.
6442	Common Water Snake (N. sipedon),	4	J. B. Gill, Berwyn.
6443	House Snake. (L. d. triangulus),	4	G. E. Showalter, Landisburg.
6448	Granite Salamander (P. glutinosus),	5	H. T. VanOstrand, Grafton.
6459	House Snake. (L. d. triangulus),	5	C. N. Witherup, Emlenton.
6463	Common Tree Toad (H. versicolor),	5	F. Oberly, Easton.
6464	(a) Granite Salamander, (b) 3 Brown Salamanders (D fusca), (c) 3 Two-lined Salamanders (S. bilineatus), (d) 7 Striped Salamander (P. Cinereus), (e) 2 Immature Salamanders,	5	W. L. King, Bethlehem.
6474	Copperhead (A. contortrix),	5	S. Johnson, Pittsburg.
6477	Pilot Snake,	6	S. Johnson, Pittsburg.
6493	Granite Salamander,	7	I. F. Mansfield, Beaver.
6500	Red-bellied Snake (S. occip.),	7	E. A. Wilcox, Sugar Run.
6504	Blue Racer (B. constrictor),	8	J. Johnson, Woodbine.
6505	(a) 4 Rock Snake (S. dekayi), (b) Red-bellied Snake (S. occi.),	8	C. F. Laurie, Erie.
6506	(a) Sculptured Tortoise (C. insculptus), (b) Newt (D. viridescens),	8	J. P. Swoope, Huntingdon.
6508	(a) Copperhead Snake, (b) House Snake,	8	W. G. Lefford, Huntingdon.
6522	Blue Racer,	8	A. B. Sharpe, Jenningsville.
6524	Pilot Snake,	8	W. F. McCord, North East.
6525	Common Garter Snake (T. sirtalis),	9	E. E. C. Gibbs, Huntingdon.
6528	House Snake,	9	Dr. I. H. Mayer, Willow Street.
6530	Map Turtle (G. geographicus),	9	A. G. Riggle, Cochrans Mills.
6531	(a) Red-bellied Snake, (b) Hoptoad (B. L. americanus),	9	A. B. Miller, Barnesville.
6534	Grass Snake (L. vernalis),	11	J. B. Miller, Chambersburg.
6541	(a) Common Garter Snake, (b) Copperhead,	11	A. P. White, Lock Haven.
6550	Copperhead Snake,	11	C. Backenstoe, Fort Hunter.
6568	(c) House Snake, (d) Brown Salamander, (e) 2 Striped Salamanders,	12	W. H. Bullock, Honesdale.
6569	Common Garter Snake,	12	A. P. White, Lock Haven.
6570	House Snake,	12	T. B. Hoover, Wellsville.
6577	Common Garter Snake,	12	J. R. Davis, Meadowbrook.
6578	(a) House Snake, (b) Pilot Snake,	12	W. H. Grimm, Hamburg.
6592	(a) Leather Snake (R. leberis), (b) House Snake, (c) Box Tortoise (P. carolina),	13	W. M. Benner, Telford.
6593	(a) Common Garter Snake, (b) Spotted Mud Turtle or Pond Turtle (C. guttatus), (c) Sculptured Turtle,	13	G. H. Bedford, Nazareth.
6595	(a) Copperhead,	13	Mrs. M. C. Brightbill, Marsh Run.
6598	2 Swift or Common Lizard (S. undulatus),	13	W. I. Keller, Beaver Springs.
6609	Common Garter Snake,	14	S. Johnson, Pittsburg.
6618	(a) 2 Red-bellied Snakes, (b) 5 Rock Snakes,	15	C. F. Laurie, Erie.
6621	Common Garter Snake,	15	W. E. Peddrick, Bellevue, Del.
6629	Sculptured Tortoise,	15	R. W. Wehrle, Indiana.
6631	Snapping Turtle (C. serpentina),	16	J. P. Lehman, Port Allegany.
6645	Common Garter Snake,	16	F. Ruof, Hummelstown.
6650	(a) 4 CommonWater Snakes, (b) Common Garter Snake, (c) House Snake,	18	J. Mell, Jr., Richland.
6652	Spotted Salamander (A. punctatus),	18	B. Fleming, Granville Summit.
6662	House Snake,	20	A. S. Ulrich, Lebanon.
6663	Leather Snake,	20	J. B. Gill, Berwyn.
6695	Common Garter Snake,	21	L. H. Hawthorne, New Castle.
6698	2 Copperheads,	21	W. E. Heintzelman, Ortanna.
6704	Purple Salamanders (G. porphyr.),	22	J. Rapp, Jr., Warren.
6705	House Snake,	22	J. W. Seip, Easton.
6707	Blowing Viper (H. platirhinos),	22	H May, Dillsburg.

Specimens Received During June—Continued.

Number.	Specimen—Insects.	Date—June, 1906.	Name and Address.
6712	House Snake,	23	S. Johnson, Pittsburg.
6721	Spotted Salamander,	25	S. Y. Godshalk, Perkasie.
6724	Common Garter Snake,	25	H. Bordner, Shamokin Dam.
6725	Ring-necked Snake,	25	R. W. Wehrle, Indiana.
6731	(a) Common Water Snake,	25	H. A. Brightbill, Marsh Run.
6763	Snake Egg,	27	W. W. Climenson, Honeybrook.
6787	Common Water Snake,	28	Dorothea S. Oppenlander, Passer.
6791	(a) House Snake, (b) Blue Racer, (c) Sculptured Tortoise,	29	W. H. Bullock, Honesdale.
6799	Copperhead Snake,	30	G. S. Reed, Baden.
6800	Copperhead Snake,	30	E. E. C. Gibbs.
	Birds and Mammals.		
6439	Crested Flycatcher,	4	Mrs. J. W. Atkinson, Buckingham.
6452	Chimney Swift,	5	E. R. Mulford, Wellsboro.
6457	Red Squirrel,	5	J. P. Lehman, Coudersport.
6458	Cedar Waxwing,	5	Molly D. Brallier, Conemaugh.
6475	2 Young Owls,	6	R. W. Wehrle, Indiana.
6527	(a) Red-winged Blackbird, (b) Purple Grackle,	9	F. S. Andrews, Wellsboro.
6540	American Goldfinch,	11	C. L. Brumbaugh, Wilkinsburg.
6554	Deer Hair,	12	R. L. Jackson, McConnellsburg.
6572	Purple Grackle,	12	A. Grener, Scranton.
6587	Chipping Sparrow,	13	Miss A. K. Bewley, Forestgrove.
6676	Part of kitten (?) skeleton,	20	E. R. Mulford, Knoxville.
6682	(a) Twilight Bat (N. humeralis),	21	Mrs. J. W. Atkinson, Buckingham.
6686	Star-nosed Mole,	21	W. W. Climenson, Honeybrook.
6699	Two-spur Chicken leg,	21	Messrs. Andrews and Mulford, Wellsboro.
6711	Balto. Oriole,	22	Mrs. S. A. Craig, Brookville.
6719	Common Mole (S. aquaticus),	23	Clara E. Mattis, Lansdale.
6746	Crow,	26	E. R. Mulford, Wellsboro.
6758	Short-tailed Shrew (B. brevicauda),	27	Mrs. J. W. Atkinson, Buckingham.
6759	Robin,	27	W. H. Bullock, Honesdale.
6778	Chipping Sparrow,	28	E. R. Mulford, Wellsboro.
6789	(a) Black-billed Cuckoo,	29	L. Winship, Moscow.



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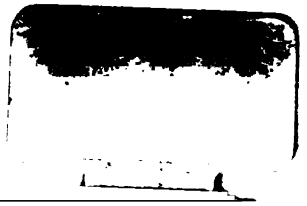

OUR MONTHLY CHAT WITH READERS.

The correspondence of this office has been so unusually heavy this fall that we have had no time to give to the special preparation of material for the October Bulletin. Since the August-September issue contains much original material on serpents, obtained by months of laborious research, and as the November issue will also contain original material on the San José Scale and similar pests, we feel justified in offering as the October issue a number of letters actually received and answered from this office. These are taken from our records, and show the variety of subjects with which we have to deal and in which many persons are interested, as we have received many communications upon the subjects here discussed.

In the future, when we receive inquiries concerning the subjects on which we have published, our reply will consist of a marked copy of some Bulletin referring to that subject if the article cover all points of inquiry. Thus this issue aids in reducing the necessary correspondence of the office, and gives us time to devote to the preparation of a reliable Scale Bulletin, which is to be published as the November number.

We have seriously contemplated reducing our increasing duties by dropping the publication of the Monthly Bulletin, or at least retaining it as a Quarterly, but the postage upon a regular periodical is so much cheaper than upon special or irregularly issued bulletins that we feel justified in continuing it as a matter of economy. Information is demanded by the public and should be given from this office. This demand could be met by special bulletins, but they would not reach as many as are now receiving our monthly publications and the postage would be much greater.

There is yet room for more names to be added to our list, and we invite interested persons to send their names and addresses. The fact that they will receive the next issue of the Bulletin is enough to show them that their requests have been given favorable attention.

Address all communications and specimens to H. A. Surface, Economic Zoologist, Harrisburg, Pa.

A TOBACCO PEST NEW TO PENNSYLVANIA.

Kinzers, Pa.

Prof. H. A. Surface, Harrisburg, Pa.

Dear Sir: I have mailed to you under separate cover some specimens of worms that are feeding upon the mature seed pods of the tobacco plant. They also burrow into the main stem, and cut off the leaves, and I have seen them cutting the tops off of half grown stalks. I find that they are increasing to an alarming extent throughout the eastern Lancaster county, and are totally destroying the seed pods. Only where seed pods are capped with paper bags, are they immune from this pest, as they have not eaten through the paper bags in my seed patch, but have cut leaves off.

I will be pleased to have your report on the specimens for the purpose of publishing in the local newspapers of Lancaster county.

Very respectfully,

J. S. W.

Reply

Harrisburg, Pa.

Mr. J. S. W. Kinzers, Pa.

Dear Sir: Replying to your valued letter of the 20th referring to the specimens of larvæ, 7,333, which you kindly sent to us, and which were eating the seed pods and leaves of the tobacco, I beg to say that they are the larvæ of a moth belonging to the large Family of Noctuidæ or the Cutworms. Unfortunately, I can not distinguish the species as they are not full grown, but we are keeping them alive to obtain further information about them. I count this a very important and valuable communication, as I have not had such a report before, and this insect is liable to prove of considerable importance. I, therefore, ask if you will kindly send us several of them with some of the tobacco as food for them. I should like to have as many as you are willing to send us, even up to the number of one hundred (with your name on the package) so that I can keep them alive and develop them and get the winged insect or moth. Thus I can learn the exact species and classification. This package may be sent by express at my expense, and as soon as I work out the life history I shall endeavor to give you as full information as possible about it. I can not at this time give you the best possible instructions as to the methods of killing this pest because this is something with which I have not had experience and upon which I can find no printed report. However, from your description, I suspect it is a climbing Cutworm, and would recommend tobacco growers to use poison bait or poison bran (mentioned in my May Bulletin), putting a spoonful of this at the base of each tobacco plant that is to be protected. I believe that the larvæ will eat the sweetened poison before they will crawl up the stalks.

Thanking you for the desired specimens, and hoping to give you further information along this line, I am,

Very truly yours,

H. A. S. Economic Zoologist.

SECOND LETTER.

Kinzers, Pa.

Prof. H. A. Surface, Harrisburg, Pa.

Dear Sir: I have mailed to you under separate cover three specimens of the larvæ that are eating the seed pods of tobacco. These are the same kind as the other two sent to you. The two moths were mailed a few days ago. I think they are caterpillars. The nits have hatched and resemble them. I find they are now disappearing or spinning cocoons.

Respectfully,

J. S. W.

Harrisburg, Pa.

Mr. J. S. W. Kinzers, Pa.

Dear Sir: I now find it possible to give you definite information concerning the insects which you mailed to us during the early part of September, and which were eating the seeds in the seed pods of your tobacco that was saved for seed purposes. By keeping these insects alive in our cages we have had the adult moths develop and come forth, and I find that the scientific name is *Heliothis rhexia*. It is one of the Cutworm Moths, and belongs to the same genus as the insect known as the Cotton Boll Worm and the Corn-ear Worm, but it is not a Climbing Cutworm, as I at first guessed it might be, and so the remedies previously suggested will not suffice. It passes the winter in the soil in the pupal or chrysalis stage, and in the summer develops into a mature moth, which lays its eggs, doubtless at the base of the blossoms, about the time the tobacco plants are in bloom, and as the eggs hatch the young bore into the capsules or seed pods and feed upon the seed. If there be not enough material within one seed pod to bring it to maturity, it will bore out of this and go to another and enter it. When it becomes a full grown larva it drops to the soil and becomes a chrysalis or pupa in the soil, and there may be a second brood emerge the same fall.

This is an insect which has been heretofore considered strictly southern in its distribution, having been previously unknown north of Maryland, and its occurrence as a pest on tobacco in your county shows that it may by a gradual northern extension and acclimatization possibly spread over most of the tobacco-growing area of this State and prove a pest elsewhere if not checked. In the south it is known to have the same habits as those which you have observed, viz., feeding in the seed pods of tobacco upon the undeveloped seeds.

For economic remedies there are three to be recommended, and instead of relying upon any one of these separately, all three should be combined where practicable: (1) Pick and burn the seed capsules as soon as they are found infested, picking by hand those individual buds which from external evidence or examination seem to have larvæ or worms in them. (2) Plow the ground in the fall and cultivate or stir it as late in the fall as possible before the time to freeze, and cultivate it again in the early spring. This will break up the soil

in such a way as to expose the pupa in its cell of earth and kill it. (3) Practice rotation of crops, planting tobacco on soil where this crop was not grown the previous year. It is possible that a fourth remedy may be found effective and satisfactory. This would be spraying with arsenical sprays, such as Paris Green and water, just as for Potato Beetles or the Codling Moth, about the time the tobacco is in bloom or as soon as possible after that. Spray the heads or tops that are to be preserved for seed, and when the egg hatches and the little larva goes to feed on the outside, preparing to bore to the inside, it will be killed, just the same as the Codling Moth is killed before it enters the apple.

I offer the above as suggestions which may be tried experimentally, and I feel confident that if the work be done at the right time, good results can be obtained. This specimen shows very plainly the importanec of the work we are doing at this office and the great value of our keeping alive those specimens which come to us until we can obtain the developed or mature insect, and learn the important biological points concerning it.

Very truly yours,

H. A. SURFACE, Economic Zoologist.

MOLE CRICKETS.

Turniphole, Pa.

Prof. H. A. Surface, Harrisburg, Pa.

Dear Sir: I am sending you herewith a speimen of bug that is eating the potatoes on the low lands. Kindly let me know what it is and the remedy for the same.

Very truly yours,

N. H. E.

Harrisburg, Pa.

Mr. N. E. H., Turniphole, Pa.

Dear Sir: The insect which you sent to us, eating your potatoes in the field is a Mole Cricket. This is described and illustrated in one of my Bulletins for 1903. It is rather surprising to me that I have received several complaints of this particular insect during the past few weeks, and at the same time I never had it sent to me but once before this summer. I desire several specimens of this insect for our school collections, and if you will kindly have a lot of these collected and sent to me by mail in a tin baking powder can, I shall return postage on them, and try to reciprocate favors. I hope you will make a special effort to get a number of these for our collection.

I have never known them to be destructive to potatoes excepting on low damp ground. Therefore, I recommend drainage and cultivation. I am sure that if the ground be well drained and frequently cultivated, these pests will give you no further trouble. I think it is

possible to kill them by placing in the soil poison baits, such as described in our May Bulletin, but I doubt if this remedy would be necessary where the soil is drained and cultivated.

Hoping that you can send me a number of specimens of this interesting insect, and that I can have an opportunity to return favors, I am,

Very truly yours,
H. A. SURFACE, Economic Zoologist.

ANOTHER ON MOLE CRICKETS.

Geneva, Pa.

Prof. H. A. Surface,

Dear Sir: I send you by to day's mail an insect I found in a hill of potatoes. The potatoes were eaten in the hills where I found them. Did these bugs do the work? What are their names?

Yours truly,
F. A.

Harrisburg, Pa.

Mr. F. A., Geneva, Pa.

Dear Sir: The specimen you sent us 7,697 is the mole cricket. This is illustrated in my September, 1903, Bulletin, which you probably have. Our supply of this number is now exhausted and if you do not have it I am sorry that I can not send you another.

The mole cricket works underground like the mole, and has been reported to me a few times in this State as doing damage, especially to potatoes. It is an unusual insect in structure and appearance and if you can send us other specimens I shall be glad to have them for our school collections. I shall be pleased to return favors in any possible way.

Yours very truly.
H. A. SURFACE, Economic Zoologist.

ANTS EXCAVATING TREES.

Bethlehem, Pa.

Prof. H. A. Surface,

Dear Sir: I have a beautiful Norway Maple shade tree in front of my property and this is being fast destroyed by an innumerable lot of large black ants. They must be hollowing it out on the inside the way they are carrying out sawdust. I have done every thing I know and heard without any benefit. Could you inform me of anything that might be done to save the tree. If so I would be thankful for the information.

Thanking you in advance, I remain,
O. H. B.

Harrisburg, Pa.

Mr. O. H. B., Bethlehem, Pa.

Dear Sir: Replying to yours of the 1st, in which you say that the large Black Ants are destroying your Norway Maple tree, I beg to say that I have for some time considered them capable of this trouble by gnawing away the decaying wood, and thus promoting or aiding decay. Although their work is only indirectly injurious, it is nevertheless objectionable. If you had described the cavities in the tree in such a way that I could know the exact conditions, I could answer you more definitely. If the hole be such that you can stop it up, you can pour benzine or gasoline into it and stop it tightly with wet paper, and they will be killed. The best thing to do is to watch the Ants and trace them to their nest and pour benztne, gasoline or coal oil on them, or put Carbon Bisulphide into a hole made in their nest with a stick like a broom handle. If they really live and rear their young in the hollow tree, you can arrange to wrap wet papers and blankets around it in such a way as to close it and fumigate them with Carbon Bisulphide. Also it will be a great help to your trees if you will clean out the decaying wood entirely and fill the cavity with Portland Cement, using one part cement and one part of clean sand. This will help the trees and keep out the Ants.

Very truly yours,

H. A. SURFACE.

PREPARING AND NAMING A COLLECTION.

Harrisburg, Pa.

Mr. F. S. A. Wellsboro, Pa.

My Dear Sir and Brother: I have been thinking of the best way of making use of your very interesting collection of insect specimens, and also your valuable literature in the Grange Hall. I think I have now worked this out. I earnestly recommend that you get another box of the same kind and about the same size as the one you have your insects in at present, and pin the specimens over from this one into the second one, and as each one is pinned down you should put the pin through a small paper label, about one-fourth of an inch wide and one-half inch long, bearing the number. These numbers may be given in consecutive order, without any regard to classification, but they should correspond with the same numbers in a note book, and for this purpose something like an account book or ledger will do very well. Leave two or three lines after each number in the book upon which you can write the common or local name of the insect if you know of its having a name, then leave a blank space for the scientific name, and write the date of capture and the food plant on which it was feeding, and anything that was observed about its habits or enemies or other points of interest. Then as new specimens are added from time to time give each its number, which we call the Accession or Addition Number, and write up the facts about it while they are yet fresh in the mind of the collector. After the Specimens are numbered with their collection number in this

way, with this on the little number slips which lie on the floor of the box in which they are to remain permanently, and which are held in place by insect pins stuck through them, they are in shape to identified or named accurately. Your young folks or others can turn to the library which you have, and by both illustrations and descriptions can find the scientific names and also the common names for most of them. These may be written in the blank space left in the note book after each number, or a sheet or chart can be made out and posted on the wall beside the collection, with the numbers in order and the name following each respective number. In this way it is not necessary to take the specimens out of the case again to put names on them, and it really is not necessary in most cases to remove them in order to study them or identify them. The less you permit dry insects to be handled by beginners, the better it is for the specimens, as they are so easily broken that beginners do not realize the damage that can be done by carelessly touching them.

I should like very much indeed to have an opportunity to work over your collection of insects for a day or two, as I am sure you have some species that we do not have, and I should like to have records of them. I particularly insist that while you have the facts concerning their collections you should record these in such a manner as to be useful to future students when the time comes that you will not be able to tell about them. It is important that the facts be recorded concerning date and locality which you know at the itme of collection. A collection without such facts is entirely useless. A scientific or careful student will find such data a most excellent means of advancing his studies.

Fraternally yours,

H. A. SURFACE, Economic Zoologist.

SPRAYING, PLANTING, BORERS AND MICE.

Durlach, Pa.

Prof. H. A. Surface, Harrisburg, Pa.

Dear Sir: There was a public demonstration held in my orchard on December 8 last, when several trees were sprayed. Before that we did not know what San José Scale was nor how to treat it.

I had nearly all my trees sprayed last spring, and the result on the trees and the fruit is such that I intend to spray them again next spring. I have bought a pump and also intend to do some spraying for my neighbors.

I also intend to plant one hundred peach trees. When would you advise planting them, this fall or next spring? I intend to spray them. Is there anything I could do to the trees or the soil to keep off the borers and mice? What varieties would you advise planting? Any help along this line would be appreciated.

Respectfuolly yours,

C. B. S.

Harrisburg, Pa.

Mr. C. B. S., Durlach, Pa.

My Dear Sir: I am pleased to learn from your letter of the 24th that the demonstration held at your place on December 8th was successful and gave you and your neighbors the help you needed in showing you how to control the San José Scale. I am also pleased to know that your spring spraying was satisfactory, and that you are encouraged to go forward and plant more trees. This sounds like business, and it is bringing you and your neighbors exactly the results that we desired when we undertook the fearful burden of helping the citizens of this State to control the scale. You note that I do not say we undertook to exterminate the scale in this State. This is impossible, but we can give such citizens as yourself and neighbors the information that will aid you in holding it in check without much expense and without a great deal of trouble, and you will be able to produce better fruit and more fruit and sell it for much better prices than though you had not had this pest force your attention to the care of your trees.

In reply to your inquiry as to when I would advise planting trees, I beg to say that undoubtedly I should prefer fall planting for pear and apple, but for peach and plum I doubt if there is much difference between fall and spring. For me it would depend upon where the nursery was situated. If south of my latitude I would prefer spring planting, and if the nursery stock came from my own latitude or the latitude northward, I would as soon as plant peaches and plums in the fall as in the spring. It gives you the advantage of doing this work when you have more time, and if they be given proper attention from severe winter, they will be all right. If you spray your young trees I would recommend that it be done just before the buds burst, when a spray with the boiled Lime-sulphur wash will prove a help to them even though they have no scale upon them.

To keep out the borers there is nothing that you can put into the soil that is recommended to be effective, but you can plant the trees and wrap them with thick paper, or even folded newspapers, being sure to wrap down close to the soil and below it, bringing the soil up around the paper, or if you do not wish to wrap them you can treat the borers with the hot solution of soap suds or dilute lye, such as is mentioned in a previous issue of my Bulletins. Put from a pint to a quart of this around the base of each tree at this time of year. This is the best time of year to treat trees for borers, and one formula that I have found satisfactory consists of one ounce of Concentrated Lye, such as is used in making soap, in each gallon of hot water. Pour a quart of this solution around the base of each tree after clearing away the gum and dirt around it, and let it stand. Do not mound it up until some time in November. Then mound it to a height of over one-half foot, and this will keep away the mice unless the snow becomes unusually deep, in which case you can tramp it around the tree, and that will keep the mice from gnawing the tree. Before winter sets in rake and burn all grass, weeds and rubbish in the orchard.

As to varieties, that depends upon what does well in your region, and you can learn that by talking with fruit growers in your locality. For my own part, if I should plant in this region I should choose

Crawford's Late, Geary, Elberta and Salway. These ripen in succession about as given here, the first being the earliest and the last the latest. For varieties, I am sure you can obtain information by writing to Prof. Geo. C. Butz, State College, Pa., or Mr. Gabriel Hiester, President of the State Horticultural Association, Harrisburg, Pa.

Hoping to serve you further, I am,

Very truly yours,

H. A. SURFACE, Economic Zoologist.

RABIES IN FARM ANIMALS.

Mr. J. H., of Doublin Mills, Fulton county, Pa., sent to this office and also to Dr. Leonard Pearson, State Veterinarian, information to the effect that a dog believed to be mad or having rabies had gone through his neighborhood biting sheep and hogs, and probably other animals. He asked what help the State would give in suppressing an outbreak of this fearful malady, and whether rabies in swine is dangerous, and if there would be any evil results from eating pork supposed to have been bitten, and what should be done with hogs which were suspected or have been attacked by a mad dog.

The reply by Dr. Pearson is so important and interesting that we here publish it in full:

Mr. J. H., Dublin Mills, Fulton County, Pa.

Dear Sir: I beg to acknowledge the receipt of your favor of the 4th instant, with regard to a disease that you believe to be rabies. Your earlier letter to the State Zoologist has been forwarded to me by Professor Surface.

From the manner in which the described dog behaved, and especially from the occurrence of disease resembling rabies in the sheep that were bitten by the same dog, I should think that there could be little doubt that the dog was actually afflicted with rabies.

In such cases it is the practice of the State Live Stock Sanitary Board to arrange for the immediate quarantine of all dogs known to have been exposed to the rabid dog and for the destruction of dogs known to have been bitten. If a number of rabid dogs have been about in a community it is of course impossible to trace the route followed by the rabid dogs and to locate all of the dogs that have been exposed. In such cases a general quarantine is established by proclamation on all dogs within a defined area.

Please advise me as to whether you have been able to gather any information as to the origin of the dog in question, or the course followed by him after he left your farm, and also whether it is believed that dogs have been exposed to attacks from this animal.

Rabies in swine is as dangerous as rabies in dogs so far as the bite of an infected animal is concerned. There is not, however, much danger that swine will carry rabies far or to many animals, because a

rabid hog does not have the opportunity to roam that a rabid dog has. So long as the hogs that you speak of behave normally and partake of their food regularly, there need be no hesitation about killing them and using their flesh. If, however, they seem to be nervous and excitable, or develop other marked symptoms of rabies, they should be kept closely confined, under careful observation, and if rabies develop they should be shot and afterwards cremated or deeply buried, and the premises occupied by them should be well disinfected by the use of a 5 per cent. solution of carbolic acid.

I shall appreciate additional information from you in regard to this matter as indicated above.

Very truly yours,
LEONARD PEARSON, State Veterinarian.

SADDLE-BACK CATERPILLAR AND SPHINX LARVA.

West Chester, Pa.

Prof. Surface, Harrisburg, Pa.

Dear Sir: I am sending you by this mail a small worm that was found on the corn, and a large worm found on grape. Will you kindly tell me what they are?

I have been trying to find a snake for you, but they seem very scarce here.

Very truly yours,
Mr. F. D. B.

Mr. F. D. B., West Chester, Pa.

Dear Sir: We have received the specimens which you sent to us, 7,852 a and b. A, or the larva feeding on the corn, is the Saddle-back Caterpillar, which is the larva of a rather plain moth which flies around our lights at night and is one of the many sometimes called Moth Millers. The scientific name is Sibine stimulea. It is one of the two caterpillars or moth larvæ which have nettle cells in their hairs, which sting like fire when one brushes roughly against them. It is called the "Saddle-back" from the shape of the spot on the back. If it should become sufficiently abundant, spray with Paris Green, regular formula, and this will kill it. In most cases it is sufficient to knock it from the infested plants with a stick and kill it by crushing it on the ground.

The specimen feeding on the grape leaves, 7,852 b, is the larva of the Sphinx Moth or Hawk Moth, such as you often see flying around certain tubular plants in the evening. It does not often become sufficiently abundant as to demand spraying, excepting on tobacco, but can be killed without any trouble by arsenical sprays. However, it is so large and easily seen, and its effects are so conspicu-

ous in eating away large portions of the leaves, that one of the best means of getting rid of it is to look over the vines, and find where it is eating, and then hunt in that region for the worm or larva until it is found, and pick it off by hand and crush it. The spine or horn on the posterior end of the body is not a sting and can not harm any one, and this insect is not dangerous at any time. There are several species of this genus and they are known as the Hawk Moths or the Humming bird Moths, because of their resemblance to the Humming bird. In a later Bulletin I may publish something more systematic about their life history and habits.

I am glad to know that you are watching for snakes for me, and I would remind you that I would also be glad to have specimens of turtles and of salamanders, commonly called lizards, and also of frogs. I think you will have no difficulty in procuring some of the little moist, slimy salamanders under stones or in damp places.

Thanking you for your good intentions, I am,

Very truly yours,

H. A. SURFACE, Economic Zoologist.

BLACK BLISTER BEETLES EATING ALFALFA.

York, Pa.

Prof. H. A. Surface, Harrisburg, Pa.

Dear Sir: I have the following from Mr. John H. Glessick: "I have a beautiful three acre lot of Alfalfa, which was sown the last week of July at the rate of 20 lbs. to the acre, and after the Alfalfa was about 4 inches high a black bug commenced to destroy it in spots. They remind me very much of the old Black Potato Bug. They tumble from the plant to the ground and I can do nothing with them." Can you give Mr. Glessick any suggestions as to how to handle this bug?

Very truly yours,

F. M.

Harrisburg, Pa.

Mr. J. H. G., R. F. D. 1, Felton, York Co., Pa.

Dear Sir: Our mutual friend, Prof. Franklin Menges, of York, Pa., has forwarded to me an inquiry concerning some Black Bugs that are destroying your Alfalfa, saying they look like the old-fashioned Potato Bugs, etc. There is no doubt in my mind but that this insect is one of the three or four species of old-fashioned Potato Beetles or Blister Beetles that are found in this State. It is a difficult insect to combat, but I should recommend sweeping the infested spots of clover with a large net. Make the net nearly two feet across, hanging it on a strong iron or wooden ring or hoop, and make it at least three feet deep. Attach to it a strong handle, and swing it back and forth through the Alfalfa in the infested spot in such a way as to capture the Beetles in the net. Then dump them into a pan of water

with a little oil floating on it. There is no method of spraying such a crop that will kill the Beetles without danger of injuring the plants or without poisoning it.

I am sending you herewith an empty mailing tube in which I wish you would please send me some of the Beetles and Alfalfa. If it should prove that they are other insects than those which I presume them to be, there may be different remedies that I can recommend, and I shall let you know. If you are not receiving our Monthly Bulletins from this office, please notify us, and they will be sent to you free of charge. They deal with insects and animal life about the farm.

Very truly yours,

H. A. SURFACE, Economic Zoologist.

RED MITES OR RED SPIDERS ON CHESTNUT LEAVES.

Hallowell, Pa.

Prof. H. A. Surface, Harrisburg, Pa.

Dear Sir: I have a goodly number of grafted Chestnuts and they seem to be suffering with the red spiders and although they are full of Chestnuts the leaves are turning brown. With what shall I spray and when?

The Editor of the "Farm Journal" says powdered sulfur will destroy them, but it is almost an impossibility to cover the trees with it properly. They are the Paragon variety.

Enclosed find samples of leaves.

Yours very truly,
W. J. H.

Harrisburg, Pa

Mr. W. J. H., Hallowell, Pa.

Dear Sir: I received the chestnut leaves you sent us and have entenered them as No. 7,811. We have examined them and find them to be turning brown from the effects of the red mite or spider, as you say. Sulfur in any form is excellent to use for this pest. I would recommend that you use flower of sulfur, putting it on large paddles and throwing it on the trees, or blowing it through a blower when the leaves are damp, either at night or early in the morning. Spraying with sulfur and water is also good. If used in liquid the sulfur should first be made into paste form by mixing it with a small quantity of water, and then stirring it into the larger quantity of water. Spraying with potassium sulphide (livers of sulfur), 1 oz. in 1 gallon of water, will also be good.

If I can give you any further help do not hesitate to write to me.

Yours very truly,

H. A. SURFACE, Economic Zoologist.

WORMS BORING CHESTNUTS.

Hallowell, Pa.

H. A. Surface,

Esteemed Friend: I have received thy letter. Thanks for advice of sulfur for red spiders on chestnut trees. But unless we use a sprayer I cannot think it practical to use the sulphur dry. If it can be mixed, as recommended, with water, very good. What will be the consequence if this pest is not dealt with? Will it destroy the trees eventually? They now have quite a red appearance.

What is the best remedy to preserve the chestnuts from insects after being gathered? Thanking you in advance for information, I am,

Very truly,

W. J. H.

Mr. W. J. H., Hallowell, Pa.

Dear Sir: Replying to your recent letter, asking for further information concerning Red Mites or Red Spiders on chestnut trees, and Sulphur treatment for the same, I beg to say that it can be thrown over the trees by using small boards as paddles, or better, blown by a "Blower" made and sold by seedsmen for the purpose. I should mix the Flowers of Sulphur with three or four parts of dry slaked Lime, if I were going to use this as a dust, and I would also recommend that this be done when the leaves are damp, as in the evening or morning. You ask concerning the consequences of leaving the Red Spiders untreated on your chestnut trees, and in reply I beg to say that this will depend upon the vigor of your trees. They may be able to live many years with such pests attacking them but not killing them. On the other hand, it certainly reduces their vitality, and the tendency will be to produce no fruits or nuts, decline in vigor, an unhealthful appearance, and probably die. It is all right to mix the Sulphur with water and apply it as a spray. Do this by putting the dry Sulphur into a vessel, and stir it well with just enough water to make it into a mush, then pour it into the amount of water that you will need to carry it in spraying. I think five or six pounds of Sulphur in a barrel of water would be sufficient, but I know of no exact formula of this kind.

After the nuts are gathered, the best remedy to keep the worms from boring them is to put them into a barrel or some other air-tight vessel, and pour into a saucer, standing over them, one-half pint of Carbon Bisulphide, and cover the barrel with a wet blanket. Thus permit the poisonous fumes from the liquid to penetrate the barrel and kill the worms, even though they are inside the nuts. Let this stand for two hours, then open it and the poisonous gas will gradually evaporate and will not prove injurious afterwards to the flavor of usefulness of the nut for eating. Of course, they can be aired after fumigating. Keep fire away from the Carbon Bisulphide, as you would from Benzine or Gasolene.

Very truly yours,

H. A. SURFACE, Economic Zoologist.

H. A. Surface,

Esteemed Friend: I must bother again about the best mode to handle the chestnut crop. In former years we gathered early and placed burrs and chestnuts before opening on barn floor, and the dampness of burrs would carry them in fine shape until they were ready to market. But now our crop is too large for that mode. It was claimed that by so doing the insects would develop and be destroyed while if left on the ground they would enter and multiply. If they are closely gathered and placed in boxes or barrels and treated with bisulphide of carbon would they taste of it? Or is a cold storage a good plan, or would that only hold the insects in check and they develop after being brought out? By aswering the above I will highly appreciate it.

Very truly,

W. J. H.

Mr. W. J. H., Hallowell, Pa.

Dear Sir: Replying to your recent letter concerning chestnut pests, I beg to say that you can fumigate them safely with Carbon Bisulphide in a barrel or tight box, and there will be no odor nor flavor remaining, and the chestnuts will not be injured in any way, but the worms will be killed by such treatment. Put the chestnuts into a tight barrel or box and set a shallow dish or pan on them, and pour into this a quantity of Carbon Bisulphide equivalent to one pound for every one hundred cubic feet of space in the vessel, or about that proportion. If you use more, it will do no harm. You can buy Carbon Bisulphide, which is the same as Bisulphide of Carbon, from E. R. Taylor, Penn Yann, N. Y., at ten cents per pound, at the factory. It is a colorless, foul-smelling liquid, the fumes of which are explosive and poisonous. Fire should be kept away from it, the same as from Gasolene or Benzine. It is not especially dangerous to handle and breathing it would not kill one instantly as would the strong fumes of Hydrocyanic Acid Gas, which I have recommended for fumigating mills and granaries. The reason for using Carbon Bisulphide instead of the other gas is that the fumes of this are heavier than air and pass downward through and between the chestnuts, and thus kill the pests that are below the vessel, while the fumes of Hydrocyanic Acid Gas are lighter than air and have a greater tendency to rise, and are thus more effective upward than downward.

Concerning keeping chestnuts in cold storage to prevent development of worms, I beg to say that I think your plan would work all right, and that the insects would be killed if the temperature were almost at freezing point, and especially if it were continued for some time. However, if it were only for a short time or not a very low temperature, I am of the opinion that it would only check them, and that they would develop after being brought out, as you suggest. I am in condition to experiment with this, and owing to the growing interest in the possible industry of producing chestnuts, and the fact that this crop has not been made profitable and can not be made profitable under the present conditions because of the pests for which no remedy is yet known, I should like to undertake the experiment along this line. Therefore if you will send me a peck or one-

PLATE XLIII.

Mole Crickets Eating Potatoes, Collected and Donated by Prof. Jno. M. Kennedy, Alden Station, Luzerne Co., Pa. (Photographed by the Economic Zoologist).

Spraying with Gasolene Power, showing Tank with Platform above for reaching high trees. From photograph taken on the premises of Mr. Jas. Boyd, near Harrisburg, Pa.

PLATE XLIV.

half bushel of chestnuts, by express, at my expense, I shall be glad to pay transportation charges and also their value, and place them in cold storage rooms at different temperatures, here at Harrisburg, and keep them for different lengths of time and examine them occasionally, taking some out from each room of different temperature and seeing under what conditions the worms will develop or die. There is a cold storage firm here, which has rooms kept at different temperatures, and thus I have an opportunity to make these experiments. I shall, of course, let you know the results, and give them, free, to the citizens of our State. They will be published in due time in my Monthly Bulletins, if I continue in office.

I hope to give you such help as is possible at any time.

Very truly yours,

H. A. SURFACE, Economic Zoologist.

FLEAS.

Berwick, Pa.

Mr. H. A. Surface, Harrisburg, Pa.

Dear Sir: Kindly inform me whether the specimen enclosed in the small envelope is a regular head-louse. If so what is a good remedy for them.

Hoping to have an early reply, I remain,

Very respectfully,

H. ——.

Harrisburg, Pa.

Mr. H. ——, Berwick, Pa.

Dear Sir: Replying to your favor of recent date, I beg to say that the insect which you sent to us is not a Head Louse by any means, and does not belong to that order of insects. It is a Flea, genus Pulex, and for such pests the best thing to do is to have cats and dogs sleep on rugs that can be beaten or cleaned in the yard, and keep such pets out of the house. Put sticky fly paper on the floor beneath beds, tables and stands. If they be so numerous as to justify it, you can easily get rid of them by fumigating by the methods mentioned in our July Bulletin. I have recently had opportunity to try this for Fleas in a large dwelling house with decided success.

Very truly yours,

H. A. SURFACE, Economic Zoologist.

GRANARY PESTS AND A BENEFICIAL PARASITE.

Secretary of Agriculture, Harrisburg, Pa.

Dear Sir: I herewith enclose a number of what our people here call Black Weevils. Also some of the wheat that they have eaten up while in the straw.

and loose stones and is not injurious. The third is a fragment of a beetle which can not be determined at present, but it does not belong to any of the species injurious to grain. The fourth is a Psocid, or one of the tree-inhabiting forms of Book Lice family (See our Bulletin for January, 1906), which feeds upon fungus material on trees, and is likewise not to be regarded as obnoxious. Therefore, you may be assured that among the specimens sent to us there are no species of pests that will injure your wheat, and from this it looks as though it were safe to store it in the bin and keep it, without going to the expense and trouble of treating it or fumigating it. I shall be glad to help you further when possible.

Very truly yours,

H. A. SURFACE, Economic Zoologist.

IMPORTED TARANTULAS.

Lock Haven, Pa.

Prof. H. A. Surface, Harrisburg, Pa

Dear Sir: Being in the fruit business, often we find a little insect (same as in the box) in a form of a spider, by the name of "Tarantula." In the dictionary it does not give ample explanation, so enclosed in a small box you will find the same, and we are very much interested to know whether this is a "tarantula," and if it is poisonous, and what injury it would cause to a person.

Glad to here from you.

Yours very truly,

A. C. & Sons.

Harrisburg, Pa.

Messrs. A. C. & Sons, Lock Haven, Pa.

Gentlemen: Replying to your letter making inquiry concerning the Specimen which you sent to us, No. 7,734, I beg to say that this is a large tropical spider, and is not a Tarantula. A great many spiders etc., are sent into this country on fruits, and there is generally more said concerning them than is justified. There are a great many reports concerning the injuries by the Tarantula, but most of these are greatly exaggerated. While it is true that this animal has a poisonous bite by which it injures its prey so that it can not escape, it is not nearly so injurious to mankind as people have been made to think. There are several species of Tarantulas, a few of which become very large, with an expanse of legs of over a circle with a radius of as much as six inches, while others are often very much smaller. They really comprise one of the several families of Spiders that are known. The tarantulas differ from the other spiders by having the claws on the jaws so placed that they work up and down or vertically instead of sidewise or horizontally, as with the other spiders. In this way you can recognize a true Tarantula at once. Its bite will not prove worse than the sting of a bee, unless it be one of the very large and rare species. I doubt if the spider which you sent

would or could be made to injure anyone. Consequently, your fears may be set at rest as to serious danger by importing these creatures accidentally with fruits. If any person should be bitten by them, there is no cause for alarm. Suck the wound immediately with sufficient force to draw out the poison and some blood with it. This is the treatment for bee stings and similar insect stings and bites. Practically no other treatment is necessary.

If you should receive other specimens, I shall be glad to have them for our collection.

Very truly yours,
H. A. SURFACE, Economic Zoologist.

BROWN ROT ON PEACH TWIGS.

Dornsife, Pa.

Prof. H. A. Surface, Harrisburg, Pa.

Dear Sir: Enclosed find four twigs taken from different peach trees. As I am not sure there is scale on them, would you kindly let me know just what the trouble is, and oblige,

Yours very truly,
B. B. L.

Harrisburg, Pa.

Mr. B. B. L., Dornsife, Pa., Northumberland Co.

Dear Sir: The peach twigs which you sent us, No. 7,810, were duly received. Upon examinataion we found no San José Scale, but we did find that they are diseased with a twig form of the Brown Rot. The brown spots or pustules are the winter or resting stage of the brown rot of peach and plum. Spraying thoroughly with the boiled Lime-Sulfur wash as soqn as the leaves are off and again just before the buds burst is the best thing you can do. This is at the same time the best remedy for the San José Scale. Some fruit growers find their trees are benefitted by this treatment and are spraying although their trees are not infested with the San José Scale.

If I can give you any further help at any time do not hesitate to let me know.

Yours very truly,
H. A. SURFACE, Economic Zoologist.

THE BORDEAUX MIXTURE; A BUTTERFLY CHRYSALIS.

McConnellsburg, Pa.

H. A. Surface, Esq.,

Dear Sir: Can I buy the Bordeaux Mixture, if it can be bought? I have no formula for it. Only need enough to spray a small pear tree.

Yours truly,
S. M. R.

ing introduced with grass seed into different parts of this State. It appears that the best way that you can get rid of it is to put the field into some crop you can hoe, and hoe the weed down as fast as the green leaves appear. Constant pulling and preventing its going to seed will in time give you success in your warfare with it. There is a U. S. Bulletin, entitled "Weeds and How to Kill Them," published by the U. S. Department of Agriculture, Washington, D. C., as one of the Farmers' Bulletin series, which you can get, free of charge, by writing for it.

Very truly yours,
H. A. SURFACE, Economic Zoologist.

BOREBS IN CORN STALKS.

Mr. H. A. Surface, Harrisburg, Pa.

Dear Sir: This season I have lost almost all my sugar corn. It came up all right and grew until from four to six inches high, when it turned yellow and the greater part of it died. What continued to grow did not reach over two feet high, and the ears have no grain on. I pulled some of it up when it started to wilt, and found that the stem was quite dead for about two inches from the grain. It had then tried to make new roots, and right in the stalk where the roots started I found a small white worm with a brown head, about half an inch long and as thick as a thread of spool cotton. About five years ago a neighbor of mine had his corn destroyed for three years in succession in the same manner. He had to sow his field in grass. This worm seems to be identical with the Cabbage Root Worm or Maggot. Cabbages were planted on the ground last year but were not badly affected. If I remove all the corn roots from the ground next fall and plough the ground and apply lime and salt, do you think it would kill the worms. If so, how much salt would it be safe to use?

Mr. T. Greiner, in The Practical Farmer, has been recommending the use of sal soda instead of lime in making Bordeaux Mixture. Six pounds of Copper Sulphate and seven and one-half pounds of sal soda in fifty gallons of water. I tried it, but if the rains had not washed it off almost at once the trees would probably have been killed, as it was, they were badly scorched. I wrote to Mr. Greiner and he says he is using the same preparation this year on egg plants, etc., and has never seen any bad effects from it. I got the Salsoda (common washing soda) in a grocery store. Is that the kind meant in the formula? I have been using "Kill-O-Scale" in the proportion of one to twenty, the past two seasons for San José Scale and have not lost any trees although some of them were pretty bad. Do you think "Kill-O-Scale" the best oil mixture on the market or do you think a strong emulsion of Whale Oil Soap and Kerosene would be effective? My employer don't want to use lime, sulphur and salt as he don't like the trees to appear white. If you will answer this at your convenience, you will greatly oblige.

Yours truly,

Overbrook, Pa. J. R.

Mr. J. R., Overbrook, Montgomery county, Pa.

Dear Sir: I can say that it is almost impossible to answer correctly questions concerning any particular kind of insect without seeing the insect itself, in order to be sure of species and habits. Of course, for those that are common, it is not necessary to have them, but for such as the one boring in sweet corn which you mention, it is very important that specimens be sent to me for examination before I can be sure to give you a correct reply that will be effective in helping to exterminate them. I note that in your letter you say that it is a small white worm with a brown head about an inch long and about as thick as a thread of spool cotton. This certainly does not agree in color, size nor shape with the Cabbage Root Worm, and besides I have never had any evidences that the Cabbage Root Worm would feed on Corn plants, and I do not think that it could be made to do so. This pest on Cabbage has no brown head whatever, and is about the size and shape of the fly larva found in decaying meat.

I think the insect injuring your Corn is the Stalk Borer, but I must see specimens to be sure. I would recommend prompt destruction of the stalks by burning so as to destroy the insects before they leave the stalks. This fall plow the ground and stir with a cultivator just before time to freeze and begin again with deep cultivation in the early spring as soon as possible. In freezing weather this will expose the insects which no doubt pass the winter in the ground, and will doubtless destroy them. At the same time I would recommend the destruction of all roots and stalks of Corn, which can no doubt be gathered by the harrow or otherwise.

I do not in general recommend the application of salt to soil for the purpose of killing insects, because most plants will not grow in soil that has been made so salty as to kill the insects that would be found in it. For a few plants which naturally thrive in soil more or less salty, such as Cabbage and Asparagus, this can be recommended but not for most cultivated plants. There will be no objection to an application of Lime to the soil in fall, but the same can be said of Lime as of salt, that when mixed with the soil in great enough quantity to kill the insects it will also kill the vegetation.

Your formula for the Bordeaux Mixture with Salsoda was just about twice as strong as it should be, and I do not understand how a person can make it as strong as this and apply it to the plants without killing them. I should use half as much Copper Sulphate and about half as much Salsoda or not more than four pounds in each fifty gallons of water. There is no advantage in this over the Bordeaux Mixture made by the Lime, excepting that the foliage is not stained by the Lime, but for my part I do not object to this on fruit trees or for any ornamental plants, excepting roses or such as grow in the dooryard. Common washing soda will do for this purpose, and of course it does have the advantage over Lime in the fact that it can be obtained in small quantity at almost any grocery store when there might be trouble to get fresh or unslaked Lime.

I do not advocate the use of "Kill-O-Scale" or any other commercial insecticide for the San José Scale. I have found during the summer that we have good results from ten per cent. Kerosene Emulsion made with Whale Oil Soap, about one pound of Whale

Oil Soap for each six gallons of water. This kills the crawling young and those young which have recently fixed. During the winter time, and especially in the spring, the best formula is, of course, the boiled Lime-sulphur Wash for killing the San José Scale, but if objection be made on account of it making the trees white one can use Whale Oil Soap, two pounds in one gallon of warm water, or Crude Petroleum or very strong Kerosene Emulsion. I see no serious objection to the white color made on the trees by the Lime-sulphur Wash, as it is certainly much better than to have the dead branches or dying trees which are liable to result from using materials which have given questionable results in our hands as well as for other persons who have used them both practically and experimentally.

Very truly yours,
H. A. S., Economic Zoologist.

THE HAIR WORM AND "CABBAGE SNAKES."

Ellwood, Pa.

Prof. H. A. Surface, Harrisburg, Pa.

Dear Sir: Inclosed find a specimen. Kindly let me know what it is, etc.

Respectfully yours,
G. A. B.

Mr. G. A. B., Ellwood, Pa.

Dear Sir: I have received the specimen which you sent and added it to our collection as 7,831. It is a Hair Worm of the genus Gordius. It is commonly but wrongly supposed to be a Horse-hair Snake, or turned into a snake from a hair. This worm is a parasite in other insects during a portion of its life. Then it becomes free and lives in pools of water. It is mentioned and its habits described in one of my former Bulletins (Vol. No. II, p. 240). In that publication I say that after going to the water and becoming an independent worm, no longer parasitic, it lays eggs, and these eggs hatch in the water and find their way into insect hosts, where they undergo their development, and from which they crawl through holes in the bodies of the insects they inhabit. The now famous cabbage snake that gave such unnecessary scare, because it was supposed to be poisonous, belongs to this group of worms. It is entirely harmless, although the cabbage snake story did a great deal of injury to the cabbage growers. It is no doubt unnecessary for me to say that this so-called Horse-hair Snake or Hair Snake, is not in any way related to the snakes or serpents, as such things do not develop from horse hairs.

Hoping to hear from you further on other subjects, I am,

Very truly yours,
H. A. SURFACE, Economic Zoologist.

EDIBLE BIRDS' NESTS OF CHINA.

Dear Sir: Please tell me about the Edible birds' nests of China, mentioned on page 25, in Bulletin for May 15, 1905. What is the name of the bird that makes it, and what is the nest like? How close does the nest resemble the Chimney Swift, and is it found in this country?

L. D.,
Etter's, R. F. D. No. 1, Pa.

Mr. L. D., Etter's, Pa., R. F. D. No. 1.

Dear Sir: The edible bird's nest of China is the nest of a bird that belongs to the same family as the Chimney Swift. It lives only in China. Its nest is shaped like that of the Swift or Chimney Swallow, but it is made entirely of a kind of glue or saliva which comes from the bird's mouth. It is not found in this country, although the Chinese import it here to some of their settlements or colonies and have it for sale. It is very much like Iceland or Irish Moss, which is one of the articles of food in stores. I understand that when boiled it is very much like tapioca.

Hoping that this answers your questions in full, I am,

Very truly yours,
H. A. SURFACE, Economic Zoologist.

FOR THE BEE MOTH.

Stroudsburg, Pa.

Prof. H. A. Surface, Harrisburg, Pa.

Dear Sir: What would you use to keep the worms from destroying frames of honey and combs?

I took about twenty frames of combs and honey away from my bees this spring. I put them in the attic and put newspapers between the hive bodies, but the other day I found that the comb was all destroyed and the honey running over the floor. I had intended to give the bees these frames of honey for winter use, but found the hives full of worms. I took the hive bodies with their contents and placed them near my bees. I left an opening large enough for a few bees to enter at a time and they are cleaning up the balance of the honey left.

Now, I am afraid that when I put my honey in the house this fall the moth worms will destroy it for me. If you can tell me how to prevent it I will feel very grateful to you, I am,

Yours very truly,
O. N. G.

Harrisburg, Pa.

Mr. O. N. G., Stroudsburg, Pa.

Dear Sir: Replying to your recent letter asking what I would do to keep worms from destroying honey and comb, I can say that I would kill them by fumigation. One way to do this is to set the frames of comb, whether they contain honey or not, into a tight box, barrel, bin or room of some kind, although I prefer a large barrel, and upon them then place a shallow dish like a plate, and pour in it at least one-half pint of the liquid known as Carbon Bisulphide or Bisulphide of Carbon, which gives off a very bad-smelling poisonous gas, which would be explosive if brought into contact with fire. Therefore, all fire should be kept away from these fumes. I do this in a barn or shed where there is no live stock at the time. As soon as the liquid is poured into the dish or tray cover the barrel with a wet blanket so that it will be gas tight. It is positively necessary that a tight box or barrel be used for this. Let it remain thus covered for two hours or more, when the cover can be removed. You should keep away from it and let it remain open until there is no odor left in it; then take out the frames and put them away and the moths will be killed in them, but watch them occasionally and if any little worms or larvæ should start, fumigate them again. This fumigation process does not kill the eggs if any be present, but a second fumigation will kill the young which hatch from the eggs. You can then put your frames into a box of some kind and cover the cracks with strips of paper put over them so that the moth laying the eggs will not get into the box. If this be done properly you can keep the comb, whether empty or carrying honey, for any number of years without worms eating it. If you wish to keep the comb in the hive box, you should close the entrance of the hive with common window screen or wire netting, so that the bee moth can not enter to lay more eggs. Do this after fumigating twice, at an interval of about a week, and during that week keep the combs away from the winged moth.

If your hives are in good condition at the present time and there is no moth in them you can store your honey which is now in the frames in empty hives by keeping the hives closed tightly, with both lid and bottom board tightly in place, and entrances closed by strips of wire netting fastened tightly over them.

You can buy Carbon Bisulphide of E. R. Taylor, Penn Yann, N. Y., at about ten cents (10c) per pound, or of your local druggists at about twice that price. If for any reason you do not care to fumigate with Carbon Bisulphide, you can use Hydrocyanic Acid Gas, made by putting Cyanide of Potassium into Sulphuric Acid and water, as described in detail in our July Bulletin. I presume you are receiving my Bulletins. If not, they will be sent to you regularly free of charge.

Very truly yours,

H. A. SURFACE, Economic Zoologist.

DATES OF FIRST KILLING FROST FOR SEVEN YEARS IN PENNSYLVANIA.

Every successful farmer understands the importance of knowing the average date of the first killing frost in his region and acting accordingly in caring for his perishable crops.

Name of Station.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
Aleppo,				Oct. 14,	Sept. 25,	Oct. 7,	Oct. 13.
Altoona,						Sept. 22,	
Aqueduct,	Sept. 23,						
Athens,	Oct. 2,	Sept. 19,	Oct. 7,				
Bellefonte,		Oct. 20,		Oct. 10,	Sept. 29,	Sept. 23,	
Butler,	Oct. 1,	Oct. 18,	Oct. 4,		Oct. 25,		
California,			Oct. 18.	Oct. 15,	Oct. 25,	Oct. 7,	Oct. 22.
Carlisle,	Oct. 1,	Oct. 18,					
Cassandra,	Oct. 1,	Sept. 19.	Oct. 2,	Oct. 22,	Sept. 29,	Sept. 21,	Oct. 7.
Center Hall,	Sept. 30,				Sept. 29,	Sept. 22,	
Chambersburg,	Nov. 7,						
Claysville,						Oct. 4,	Oct. 13.
Coatesville,	Oct. 2,	Oct. 20,	Sept. 25.	Oct. 23,	Oct. 29,	Sept. 22,	Oct. 30.
Coopersburg,		Oct. 20,					
Derry Station,	Nov. 4,		Oct. 17,			Sept. 22,	Oct. 6.
Dushore,	Sept. 14,	Sept. 19,	Sept. 20,	Sept. 15,	Sept. 30,	Sept. 22,	
Dyberry,	Sept. 14,	Sept. 19,	Sept. 20,	Sept. 6,			
Easton,	Oct. 1,		Oct. 25,	Oct. 22,		Sept. 22,	
Emporium,	Oct. 2,	Oct. 17,	Oct. 4,	Oct. 10,	Sept. 29,	Sept. 22,	Oct. 26.
Ephrata,	Oct. 1,	Oct. 20,	Oct. 7,	Oct. 10,	Oct. 25,		Oct. 22.
Erie,			Nov. 19.			Sept. 23,	Oct. 26.
Everett,			Sept. 19.	Oct. 21,	Oct. 27,	Sept. 21,	Oct. 21.
Franklin,	Nov. 13,	Oct. 20,		Oct. 10,			
Freeport,					Sept. 29,	Sept. 21,	
Gettysburg,						Sept. 23,	Oct. 22.
Gordon,					Sept. 30,	Sept. 22,	
Grampian,	Sept. 30,	Oct. 17,	Oct. 3,		Sept. 19,		
Greensboro,	Sept. 30,	Oct. 17,					
Greenville,					Sept. 29,	Sept. 21,	Oct. 26.
Hamburg,	Oct. 1,						Oct. 30.
Hamilton,	Sept. 14,		Sept. 10,	Oct. 10,			
Hamlinton,					Oct. 18,		
Hanover,						Oct. 16,	Oct. 22.
Harrisburg,	Oct. 1,	Oct. 20,	Nov. 7,			Oct. 24,	Oct. 30.
Hawley,	Sept. 15,						
Hawthorn,	Oct. 1,				Sept. 26,		
Huntingdon,	Oct. 1,	Oct. 10,	Oct. 4.	Oct. 15,	Oct. 25,	Sept. 22,	Oct. 22.
Indiana,					Oct. 21,	Sept. 23,	Oct. 22.
Irwin,			Oct. 3,	Oct. 8,	Oct. 25,	Sept. 21,	Oct. 21.
Johnstown,	Oct. 1,	Oct. 17,	Oct. 4,	Oct. 15,	Oct. 28,	Sept. 23,	
Kennett Square,				Oct. 22,		Oct. 8,	
Lancaster,	Nov. 7,						
Lawrenceville,	Sept. 29,			Oct. 11,	Oct. 21,	Sept. 22,	
Lebanon,	Oct. 1,	Oct. 10.		Oct. 10,		Sept. 23,	Oct. 23.
Le Roy,	Oct. 1,	Oct. 20.	Oct. 4.	Oct. 10,	Sept. 30,	Sept. 22,	Oct. 23.
Lewisburg,	Oct. 1,	Oct. 20,	Sept. 20,	Oct. 22,	Oct. 25,	Sept. 22,	Oct. 22.
Lock Haven,		Oct. 20,	Oct. 25.		Oct. 26,	Oct. 7,	Oct. 26.
Lycippus,	Oct. 2,			Oct. 10,			
Marion,						Sept. 22,	Oct. 22.
Mauch Chunk,	Nov. 14,	Oct. 18,	Oct. 6.	Nov. 29,	Oct. 25,	Sept. 23,	Oct. 23.
Mifflintown,					Oct. 20,	Sept. 22,	Oct. 26.
Milford,					Oct. 25,	Sept. 23,	Oct. 22.
Montrose,					Oct. 25,		
New Germantown,					Oct. 25,	Sept. 22,	Oct. 7.
Philadelphia,	Oct. 2,	Nov. 15			Nov. 7,	Oct. 29,	Oct. 22.
Pittsburg,	Oct. 1,		Nov. 2,	Sept. 17,	Oct. 25,	Oct. 7,	Oct. 22.
Pocono Lake,			Sept. 20.				
Pottstown,			Oct. 7.	Oct. 10,			
Quakertown,	Oct. 1,	Oct. 17,	Oct. 7.		Oct. 25,	Sept. 23,	
Renovo,	Oct. 1,			Oct. 8,			
Saegertown,	Sept. 15,			Oct. 10,		Sept. 23,	Oct. 26.
St. Marys,							
Scranton,	Oct. 2	Oct. 18	Oct. 7.	Oct. 10,	Oct. 25,	Sept. 22,	Oct. 25.
Selins Grove,	Oct. 1	Sept. 19.	Sept. 20		Sept. 25,	Sept. 23,	Oct. 23.
Shingle House,	Sept. 13.						
Skidmore,						Sept. 22,	
Smethport,				Sept. 13,	Sept. 30,	Sept. 22,	
Somerset,	Sept. 14.	Oct. 15.	Oct. 3,	Oct. 10,	Sept. 19,	Sept. 16.	Oct. 13.
South Bethlehem,			Oct. 20.	Sept. 6,			
South Eaton,	Oct. 1	Sept. 19.	Sept. 20	Oct. 10.	Oct. 25.	Sept. 22.	Oct. 22.
State College,	Sept. 30.	Sept. 19			Oct. 13	Sept. 21,	Oct. 22
Swarthmore,						Sept. 22,	
Swiftwater,	Oct. 1.						
Towanda,	Oct 2	Oct. 18	Oct. 7		Oct. 25	Sept 22	Oct. 22.
Uniontown,	Oct. 1.				Oct. 28.		
Warren,	Oct. 2.			Sept. 6		Sept. 21	Oct 25.
Wellsboro,	Sept. 14.	Sept. 19	Oct. 4	Oct. 22	Sept 29.	Sept. 22,	
West Chester,	Oct. 2.					Sept. 22	Oct. 22.
Westtown,	Oct. 2.	Oct. 18.	Oct. 4	Oct. 22.			
Wilkes-Barre,	Sept. 29	Sept. 19,		Oct. 30		Sept. 22,	
Williamsport,	Sept. 13,	Sept. 19,		Oct. 22.	Oct. 22,	Sept. 23,	Oct. 26.
York,	Oct. 1.	Sept. 19,	Sept. 26		Oct. 26,		

SPECIMENS RECEIVED DURING JULY, 1906.

To our many voluntary contributors we are indebted for the aid they have given our studies in sending the specimens listed below:

Number.	Specimen—Insects.	Date—July, 1906.	Name and Address.
6811	Lecanium,	2	J. Cope, Kennett Square.
6812	Luna Moth,	2	A. E. Norton, Waymart.
6817	Cecropia Moth,	2	Mr. Stauffer, Mechanicsburg.
6822	Lecanium,	3	L. W. Ritz, Lebanon.
6824	Cutworm Moth (Agrotis sp.),	3	C. T. Harbaugh, Sewickley.
6825	(b) Buprestid Beetle,		
	(c) Ground Beetle,		
	(d) Flies,	3	J. G. Care, Irvona.
	(e) Butterfly (Argynnis sp.),		
6826	Lecanium,	3	Mrs. J. G. Taylor, Philadelphia.
6828	Cecropia Moth,	3	E. Gilbert, Bechtelsville.
6829	Papaipema nitela larvae,	3	F. G. Cain, Columbia.
6831	Giant Water Bug (B. griseus),	3	N. Hatzwick, State College.
6834	Mud Wasps Nests,	3	Miss Maud Robertson, Palmyra.
6835	(a) Work of Cucumber Beetle,	3	Miss M. S. Paxson, Carversville.
6836	Kermes,	3	E. H. Bonsall, Philadelphia.
6839	(a) May Beetles,		
	(b) Click Beetles,	4	J. Fish, Arnot.
6840	Long-horn Beetle (P. laticollis),	4	J. A. Long, Brookville.
6841	Long-horn Beetle (P. laticollis),	4	W. H. Lightner, Shirleysburg.
6843	Thalessa sp.,	5	W. H. Weaver, Shamokin.
6847	(a) Wooly Maple Aphis,	5	McCormick Estate, Rose Garden.
6849	Crambus Larvæ,	6	M. D. Hartzhorn, Utica.
6852	Lecanium,	6	C. H. Smith, Cove Forge.
6853	Canker Worm Egg Shells,	6	J. Hopkins, Juniata.
6855	Cecidomyia galls,	6	Dr. I. M. Weills, Harrisburg.
6862	(a) Blister Beetle (M. unicolor),		
	(b) Lightning Beetle,	7	W. H. Keener, Adah.
6863	Eyed Elater,	7	L. Depp, Brookville.
6865	(a) Syrphid Fly Pupa,	7	G. H. Bedford, Nazareth.
6868	Lecanium,	9	W. K. Shissler, Pottsville.
6869	Helgamite,	9	F. V. Braymer, Blooming Valley.
6873	Coleoptera Larvæ,	9	Mrs. S. A. Jones, Carlisle.
6874	Lecanium,	9	Hon. G. D. Orlady, Huntingdon.
6875	(a) Aphis Skins,	9	G. C. Comstock, Montrose.
6876	San José Scale,	9	J. Britzman, E. Stroudsburg.
6877	San José Scale,	9	Miss Bessie Helwig, Catawissa.
6880	San José Scale,	9	A. J. Winder, Wilkes-Barre.
6882	San José Scale,	10	G. S. Yohe, Spring Forge.
6883	Bag Worms,	10	J. McEwan, Glasgow.
6884	Catalpa Sphinx,	10	H. S. Williams, Rosemont.
6885	Parasitized Larva (Schizura ipomeæ),	10	E. E. Erdman, Shamokin.
6887	Polyphemus Moth,	10	D. B. Edleman, Fleetwood.
6888	(b) Blister Beetle (M. unicolor),	10	T. Fennell, Cannelton.
6894	(b) Cecidomyia Galls,	10	Miss Anna K. Bewley, Buckingham.
6895	Caddis Flies,	11	R. W. Wehrle, Indiana.
6898	Twig Borer in Quince,	11	H. C. Beitel, Easton.
6899	Assassin Bug (A. multispinosa),	11	H. W. Anderson, Stewartstown.
6900	Fall Webworm (H. cunea),	11	Julia G. Mallson, St. Mary's.
6901	San José Scale,	11	Julia L. Lilley, Montgomery.
6906	Dragon Fly,	12	W. F. Shafer, Cogan Station.
6907	(b) Work of Rose Chafer,	12	G. A. Taylor, Parulack.
6911	Clover Wheel (P. nigrostris),	12	G. P. Singer, Lock Haven.
6912	Pine Sawfly Larvæ	12	Mercersburg Academy, Mercersburg.
6915	Rose Scale (A. rosæ),	13	J. S. Strickler, Waynesboro.
6920	Scurfy Scale,	13	O. A. Hotchkiss, Saegerstown.
6921	Pentatomid, Podisus sp.,	13	A. Lyman, Coudersport.
6922	Ox Warble Fly,	13	N. R. Jewett, Montrose.
6927	Insects,	14	H. Barrington, Harrisburg.
6928	Insects,	14	M. Hemperly, Lancaster.
6931	Striped Cucumber Beetle,	14	T. H. Shields, New Bedford.
6932	Scurfy Scale,	14	M. C. Keister, New Cumberland.
6935	Fall Webworm,	16	F. S. Andrews, Wellsboro.
6936	Leaf Chafer (O. eremicola),	16	Miss Kathryn Hughes, Tioga.
6937	Assassin Bug (O. personata),	16	E. E. C. Gibbs, Huntingdon.
6938	(a) Io Moth,		
	(b) Imperial Moth,	16	W. K. Warden, Oxford.
	(c) Sphinx (A. choerilus),		
6939	Scurfy Scale,	16	E. Wells, Wilkes-Barre.
6940	Cells of Leaf-cutting Bee,	16	A. W. Shaw, Erie.
6941	Maple Pseudococcus,	16	W. D. Rhodes, Danville.
6943	Beetle (B. cordicollis),	16	W. H. Bullock, Honesdale.
6945	Snout Beetle,	16	H. J. O'Connor, Harrisburg.
6946	Polyphemus Moth,	16	J. Baker, Harrisburg.

Specimens Received During July—Continued.

Number.	Specimen—Insects.	Date—July, 1906.	Name and Address.
6951	(a) Oyster-shell Scale, (b) Jassids,	17	J. S. Klase, Snydertown.
6952	(b) Mosquito Hawks and Crane Flies.	17	P. A. Oliver, Oliver's Mills.
6954	(b) Eyed Elater,	17	W. Sarson, Okome.
6956	Sphinx Larva,	17	Mrs. J. A. Williams, Sayre.
6957	Lecanium,	17	W. M. Emerick, Shamokin.
6958	Psocids,	17	J. F. Bucker, Waynesburg.
6959	(a) Scurfy Scale, (b) Oyster-shell Scale,	17	Miss A. Edinger, Emlenton.
6960	(a) Lecanium,	17	W. W. Brakeman, Harrisville.
6964	Sphinx Moth (S. cheris),	17	A. Kinyon, Columbia Cross Roads.
6966	Insects,	18	I. F. Mansfield, Beaver.
6967	(a) Moth pupa, (c) Darkling Beetles,	18	W. H. Bullock, Honesdale.
6968	San José Scale,	18	A. T. Zech, Seven Valleys.
6969	San José Scale,	18	F. J. Douden, Lykens.
6972	(a) Oyster-shell Scale, (b, c and d)Synip Galls,	18	A. M. Yingling, Altoona.
6974	Pear Slugs,	18	J. S. Shaw, Wallaceton.
6975	Polyphemus Moth,	18	W. Wilson, Harrisburg.
6979	Polyphemus Moth,	19	Geo. Barnes, Harrisburg.
6980	Bag Worms,	19	M. V. Dissinger, Marysville.
6981	Seventeen-year Cicada,	19	Mrs. G. P. West, Danville.
6982	(a) San José Scale, (b) Phylloxera, (c) Cynip Galls,	19	J. Vallerchamp, Halifax.
6983	Tree Hopper Egg punctures,	19	R. Richardson, Buckmansville.
6988	(a) San José Scale, (b) Scurfy Scale,	20	Holmes Seed Co., Harrisburg.
6991	Lecanium,	20	John H. Shellenberger, McAllisterville.
6992	Oyster-shell Scale,	20	Mrs. I. Doolittle, Pleasantville.
6994	Beetle (C. argus),	20	A. C. Keeney, Laceyville.
6995	Flea Beetles (T. cancllus),	20	Mr. Brenneman, Harrisburg.
6996	Lecanium,	20	A. B. Russel, Springdale.
6997	Chalcid Pupæ,	20	M. L. Cook, Wyalusing.
6998	Fall Webworm,	20	G. B. Gray, Rush.
7002	Lady Beetle pupa shells,	21	A. J. Hetrick, Millerstown.
7005	Lady Beetle pupa shells	21	H. M. Gooderham, Patton.
7006	(a) Scurfy Scale,	21	J. T. Black, Glenhope.
7008	Katydid Eggs,	21	E. M. Paxson, Solebury.
7009	Scurfy Scale,	21	Mrs. H. M. Patton, Sandy Lake.
7013	Leaf Beetle (G. rufosanguinea),	23	A. H. Sinsabaugh, Wyalusing.
7014	Pentatomid podisus sp.,	23	A. Lyman, Coudersport.
7016	June Beetle (A. nitida),	23	W. Batty, Lenni Mills.
7017	Rosy Maple Moth (G. rubicunda),	23	G. W. T. Warburton, Granville Summit.
7018	San José Scale,	23	A. S. Camera, Bowmanstown.
7019	Lecanium,	23	R. Trimble, Pittsburg.
7029	Lecanium,	24	J. A. Witherspon, Mercersburg.
7030	Spotted Pelidnota,	24	E. Buckloeu, Benton.
7031	Locust Leaf (Cecidomyia robinæ),	24	J. M. Hoffer, Mt. Joy.
7032	(a) Sphinx Moth (P. pandorus), (b) Polyphemus Moth, (c) Imperial Moth,	24	C. L. Kiner, Wormleysburg.
7036	Cecropia Larva,	24	Mrs. J. B. Taylor, Overbrook.
7037	Cicada Egg Punctures,	24	F. R. Waring, Tyrone.
7038	Sphinx Larvæ (S. abbottii),	24	A. Twining, Scranton.
7039	(a) Squash Bug, (b) Lady Beetle (E. borealis),	24	O. T. Everhart, Hanover.
7040	Beetles (C. argus),	24	A. C. Kinney, Laceyville.
7044	Boring Beetles (Ptinidæ),	24	J. S. Hunter, Grove Summit.
7045	Scurfy Scale,	25	D. B. Trout, Blandon.
7047	Lecanium,	25	J. F. Meyer, Spring Mills
7049	(a) Leaf Chafer (O. scabra), (b) Hawk Moth larva,	25	W. H. Bullock, Honesdale.
7050	Polyphemus Moth,	25	C. P. Miller, Sharon.
7051	Blister Beetle (M. unicolor),	25	J. H. Rittenhouse, Smock.
7052	Sphinx Moth (D. lineata),	25	P. A. Small, York.
7054	San José Scale,	25	H. Swartz, Gardenville.
7056	(a) San José Scale,	25	W. J. Guyer, Mechanicsburg.
7060	Beetle (L. dama), Stag Beetle,	26	Mrs. J. W. Atkinson, Buckingham.
7063	San José Scale,	26	M. Snyder, Fisher's Ferry.
7064	Lecanium,	26	A. Nevel, Huntersville.
7066	Dogday Cicada,	26	E. Brickley, Harrisburg.
7067	Fly Larvæ,	26	Mr. Brenneman, Harrisburg.
7071	Oyster-shell Scale,	27	A. W. Wright, Colfax.
7072	Psocids,	27	D. W. Dietrich, Lititz.
7073	Psocids,	27	Q. W. Chase, Rome.
7075	Psychid Moths,	27	W. K. Warden, Oxford.
7081	Common Wasp (Polistes sp.),	28	W. F. Hill, Chambersburg.
7083	Fall Webworms,	28	B. L. Tyler, Damascus.
7084	Moth Larva (H. undulata),	28	P. A. Small, York.
7091	Sawfly Larvæ (C. americana),	30	H. Barrington, Harrisburg
7092	Psycid Moths,	30	G. M. Branthaver, Chambersburg

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(To be concluded next Month.)

OUR EXPERIMENTS.

Each month we publish the results of some personal experiments or investigations. The public knows that these can not be made without facilities or opportunities, such as apparatus and places for experimentation. In spraying for the San José Scale the chief requisite is trees infested with these pests. The public also knows that we have no experiment station at or near Harrisburg, as the State Experiment Station is in Centre county, over one hundred miles from this office. In order to save the time that would be lost in travel, the State Zoologist has recently leased a small infested orchard and moved to the vicinity of Harrisburg, in order to concentrate his work at one point and render the citizens greater service.

There is no San José Scale and consequently no opportunity for this kind of experimentation at the State Experiment Station, and there are no public grounds with infested trees available elsewhere in this State. For the past three years we have depended upon obtaining permission of fruit growers near Harrisburg to experiment on their premises. We found that as long as our work was resulting beneficially to their trees the owners had no objections to offer, but when through the use of some material too strong for the trees, the latter were injured, or by the application of some experimental material too dilute, the scale was not killed and continued its serious attacks, the owners objected to losing their property for the benefit of the State, without compensation. In order to meet this condition of affairs and have trees that could be treated on "the kill or cure" plan, we leased a small plot of ground at Camp Hill, a suburb of Harrisburg, having thereon two acres of badly infested apple trees of full size, some of which were entirely dead, others hopelessly injured by the scale, others moderately infested and others only slightly attacked. This was an ideal condition for experimentation, and with our assistants we have worked early and late, at intervals during the summer, spraying these trees not only for the San José Scale, but also the few that bore fruit were sprayed experimentally with different substances for the Codling Moth, and accurate records were kept of each test, with a view toward publishing the same. We were authorized by the owner to perform any desired experiments, without regard to fore-seen beneficial results on these particular trees. Some of the trees were severely cut back and entirely painted by hand with such materials as very thick Whale Oil Soap, the boiled Lime-sulphur Wash, Crude

which has an oil for its basis. The next step is to spray the same trees in the spring with the boiled Lime-sulphur Wash applied in two good coats just before the buds burst. Thoroughness of application, which means a good double coating, is absolutely essential. No man is justified in mixing together some Lime and Sulphur without boiling it, and applying it to his trees, and saying that the Lime-sulphur Wash does not give good results. Neither is he justified in spraying his trees imperfectly, covering them only in spots, and leaving millions of scales uncoated and alive, and then report that spraying is not successful. Let him follow directions carefully as to the methods of preparing and applying the Lime-sulphur Wash, doing this at the right time of year, and after he once succeeds in controlling the scale, he will not need to spray more than once every year or two, but he will be anxious to do so, because of the beneficial results in other ways than destroying the Scale. As a fungicide this material, applied in the spring, prevents the Peach Leaf Curl, and is one of the steps toward preventing Peach Rot, known also as Brown Rot and Ripe Rot. When there are Borers around peach trees one of the best things that can be done is to clear away the mass of gum and dirt with a hoe and turn the nozzle upon the base of the tree, spraying about a quart of the liquid against the base of each tree attacked by Borers.

While the above report is not given in tabulated detail, it must be taken as a personal and honest report of the exact conditions that were found this spring and summer in an experimental orchard.

THE SAN JOSE SCALE IN PENNSYLVANIA.

As the season for spraying is now near it becomes appropriate to consider important points in the life of this pest and particularly the best measures for its control. Most of these subjects have been briefly treated in previous issues of our Monthly Bulletin (especially for November, 1905, and February, 1906), but the editions of those Bulletins are now almost exhausted, and as we are receiving many requests for such information, which is so seriously needed in this State at present, it is here given with the hope that it will be of some use to the thousands of persons whose trees are now being destroyed by the pests herein discussed. It is very important for all persons having trees to ascertain if the San José Scale be upon them, and if so to treat them thoroughly in the proper manner before the buds burst in the spring. Send to us twigs supposed to be infested.

1. Names and Pronunciation.

The San José Scale has a scientific name which is indicative of its bad character. This is *Aspidiotus perniciosus* The first or generic name refers to the shell or scale which covers the small soft-bodied insect, and its second or specific name properly refers to its pernicious effects. The common name of this pest is given from the old Spanish town in California into which it was first introduced, in the United States, although the citizens of California declare it is unjust to call this the "San José Scale," as it did not originate there but merely tarried a while on its way across the country. The pronunciation and accent of that city's name are in accordance with the Spanish language—"San," rhyming with "pan," and "Hosay." Thus the name is not "Jose" (rhyming with "rose"), as it is pronounced by many persons.

2. Origin and Introduction into Pennsylvania.

In giving the information necessary to successfully control this serious pest it is not necessary to discuss at length its origin or history, but these points are of some interest and worthy of mention. The native home of the San José Scale is the northern part of China, in the region of the Great Wall, where it lives on fruit trees and other woody plants, and has been known so long that there is no record of its origin, but it has been held in check there by its natural enemies, so that it has not over-ridden everything in that country, as it has here. An attempt was made to introduce some of these enemies of the Scale into America, but only one species of lady beetle was brought into this country; while there are no doubt many other insects which destroy this pest in its native region. The introduced Chinese Lady Beetle was found to be so attacked by parasites, in turn, that it was destroyed by them and has not thrived in this country. False hopes have been raised concerning the destruction of the San José Scale by means of its natural enemies, and while this is at least worthy of experimentation, nothing has yet been accomplished that could be called successful in this direction. All economic entomologists agree that the only way to save our orchards and produce fruit is to prepare to fight this pest with modern insecticides and apparatus.

This pest was accidentally carried on plants from China to Japan, and in the effort to introduce a Curculio-proof Plum the Japanese plum was brought in an infested condition to San José, California. About 1887 some enterprising nursery firms in New Jersey procured from California a number of Japanese plum trees which were hoped to be Curculio-proof, but unfortunately were infested with a more serious pest than the Curculio, viz., San José Scale. About

1890 and 1891 this destroyer of trees was sent on nursery stock to a few localities in Pennsylvania, Virginia and a few other Eastern states, and it was not until after these trees commenced to grow in the orchards that the presence of this pest in Eastern United States was discovered. From that time it has gradually spread by various means mentioned later, until millions of dollars would be required to pay for the loss that our fruit growers have sustained from its ravages. During the past fifteen years all other fruit pests combined have not proven so destructive as has this one—by far the smallest of all in size, but vastly more abundant in numbers and more certain and deadly in effect.

3. Methods of Injury and Effects.

The San José Scale, like all other scale insects, attacks its hosts or food plants by sinking a long proboscis through the outer bark and into the sap-bearing inner bark and sometimes even into the soft wood. After having thus become fixed it is impossible for it to be freed without breaking off the proboscis and thus killing the scale. It commences at once to inject a poisonous liquid into the part of the tree attacked and this often results in conspicuous red specks upon the fruit and twigs. This is particularly noticeable upon plum, apple and pear and also upon the green tender shoots of peach branches. It differs from other scale insects in the fact that its injected liquid appears to be more poisonous to the trees than is that of any other species of this large family of pests. We know that some insects bite and sting us with greater pain than do others, and there is all reason to believe that in the pests which attack vegetation by sucking some are more severe in their attacks upon the trees than others. The San José Scale, although certainly the smallest of such pests, is at the same time the most destructive as well, because of its immense numbers and severe effects.

The poison in the infested apple and pear trees can often be detected by scraping away the tough outer bark and disclosing the crimson or purple stain in the inner bark. After modifying the sap of the tree by this injection of poison, just as the mosquito modifies or slightly changes our blood by the injection of its poison, the scale insects suck the sap from the trees, utilizing it for their own sustenance. The mere loss of sap by the myriads of these pests is not nearly great enough to account for the very serious results upon vegetation.

The infested trees can be detected even at a distance by their appearance of gradual decline. The injured twigs commence to die at the tips, as nature tries to keep the tree alive at the center or toward the base. Often the interior of the heads will be bushy, but the long bare dead branches will be seen reaching out beyond

them, thus telling of the effects of the scale. Toward the last stage of the life of the tree small shoots will often be found starting out from the trunk or larger branches, and sometimes strong sprouts will grow up from among the roots.

The San José Scale especially fixes upon the growing fruit of the plum, pear and apple, partly because these fruits are hard and smooth and furnish a good situation, and partly because the twigs, of apples especially, are often densely fuzzy and do not prove to be good places for the scale to fix. It is owing to the fine fuzz of the peach that the scale does not generally attack the fruit of this tree to any great extent, as it does the fruits of the others just mentioned. Its appearance upon fruit of any kind need not be considered alarming, as it can not possibly spread from fruit that has begun to ripen, because it dies on such fruits, and can not reproduce from them.

We have been asked if it "would be safe to wash, peel and cook the fruits carrying the scale, and eat them without danger of being poisoned." Such precautions are by no means necessary. To eat infested fruits raw and unwashed, would be more disastrous to the scale than to the consumer. The latter need not fear any evil results. In this connection it should be explained that sometimes a careful spraying of the trees results in driving many scale insects from the trees to the fruit, for the reason that it does not readily fix upon the branches or twigs covered by the Lime-sulfur Wash, and the leaves, being fuzzy, do not afford a good abiding place. Thus the only thing to be done by the insects is to fix on the fruit where it may appear in considerable numbers, although possibly it may not be found in great numbers on other parts of the tree. Repeating the spraying when the leaves are off will give better results on fruit of the same tree the following year.

4. Kinds of Plants Attacked by San José Scale.

The San José Scale is not a serious enemy of all kinds of trees and shrubs, as has been published by persons who do not know the pest by personal experience, yet it does attack a greater number of plants than any other pest found in this State. We have had it sent to us on tomatoes, and have found it upon golden rod and other weeds, but this was not important as it had simply fallen upon such plants from fruit trees upon which it was abundant, and was forced to fix itself and try to exist upon whatever growing plant it chanced to be upon, as it had no choice and could not do otherwise.

A mere list of the kinds of plants upon which San José Scale has been found or may be found in regions where it is very abundant is comparatively useless and misleading from the fact that it is

known to fix upon almost any kind of plant, tree, shrub or vine, to which it is carried by natural agencies when in the young and free-moving stage, but it will by no means thrive or multiply upon all of them. Just as there are certain plants that cattle will not eat excepting under the most dire necessity, while there are others they prefer, so are there trees, such as the sycamore, yellow locust, maples, poplars, and others that the San José Scale is known to attack when it is abundant in the neighborhood upon other kinds of trees on which it thrives well, but it will not develop upon these to an injurious extent. The cultivated plants upon which it is most destructive and which therefore should be watched for its presence, are nearly all varieties of fruit trees, excepting the following: Sour cherries, wild goose and similar varieties of plums, and the Kieffer pear (the Kieffer but rarely being attacked). It is not usually injurious to quinces, but at times is very destructive to sweet cherry and will attack all varieties of peaches and kill them in two or three years, while it destroys currant bushes, all varieties of apples, most varieties of plums and pears, the osage orange such as is used for hedging, flowering quince or Japan quince, mountain ash, shadberry or June berry, and some other varieties of ornamental plants and shrubbery, but not all by any means. The conifers, commonly called evergreens, and most forest trees, are free from its attacks. In regions where it is abundant we always find a much larger variety of plants attack by it than where it has started but recently.

Upon some plants; such as the grape vine, it will not generally be so abundant as to become the cause of alarm, yet at some places where the supporting trees have been killed by this pest and nearly all fruit trees were infested by it, we have seen grape vines killed by its attacks as they were climbing over infested peach trees. Had the vines not been in such close contact with a tree upon which the scale multiplies so rapidly, they would not have been so seriously attacked. A mere list of plants that have been known to be infested does not give much useful information for the reason that it does not express the degree of injury to which each particular kind of plant is susceptible. We give herewith two lists, the first of which is of plants commonly or badly infested, the second is those species only occasionally or rarely infested. Excepting for accidental omissions, all species of plants not mentioned below are free from danger by the San José Scale.

Plants Commonly and Rarely Known to be Infested with San José Scale.

(From Second Report of the State Entomologist of Connecticut—W. E. Britton, State Entomologist.)

1. List of Hardy Trees, Shrubs and Vines Commonly Infested.

Acacia, sp.
Akebia, sp.
Akebia quinata.
Almond, (Prunus amygdalus).
Almond, Flowering, (Prunus Japonica).
Apple, (Pyrus Malus).
Apricot, (Prunus Armeniaca).
Ash, American Mountain, (Sorbus, sp.).
Ash, European Mountain, (Sorbus aucuparia).
Basswood, Linden, (Tilia, sp.).
Beech, European or Purple-leaved, (Fagus sylvatica).
Cornus Baileyi.
Cornus sanguinea.
Cotoneaster, sp.
Cotoneaster vulgaris.
Crabapple, (Pyrus, sp.).
Crataegus cordata.
Crataegus Crus-galli.
Currant, (Ribes rubrum).
Currant, European, (Ribes nigrum).
Currant, Flowering or Missouri, (Ribes aureum).
Cherry, Choke, (Prunus Virginiana).
Cherry, Sand, (Prunus pumila).
Cherry, Sweet, (Prunus Avium).
Cherry, Wild Black, (Prunus serotina).
Dogwood, White, (Cornus alba).
Elm, (Ulmus, sp.).
Elm, American, (Ulmus Americana).
Elm, European, (Ulmus campestris).
Gooseberry, American, (Ribes Oxyacanthoides).
Hawthorne, (Crataegus, sp.).
Hawthorne, English, (Crataegus Oxyacantha).
Hoptree, (Ptelea trifoliata).
Japanese Quince, (Cydonia Japonica).
Juneberry or Shadbush, (Amelanchier Canadensis).
Lilac, common, (Syringa vulgaris).
Lilac, Persian, (Syringa Persicæ).
Linden, American or Basswood, (Tilia Americana).
Orange, Sour, (Citrus trifoliata).
Orange, osage, (Toxylon pomibrum).
Peach, (Prunus Persicæ).
Pear, (Pyrus communis).
Pear, Sand, (Pyrus sinensis).
Plum, Beach, (Prunus maritima).
Plum, European, (Prunus domestica).
Plum, Japanese, (Prunus trifoliata).
Plum, Purple-leaved, (Prunus Cerasifera).
Plum, Wild Goose, (Prunus hortulana).
Poplar, (Populus, sp.).
Poplar, Carolina, (Populus deltoides).
Poplar, Lombardy, (Populus nigra, var Ital.).
Privet, common, (Ligustrum vulgare).
Quince, common, (Cydonia vulgaris).
Quince, Flowering or Japan, (Cydonia Japonica).
Rose, (Rosæ, sp.).
Rosa Carolina.
Rosa mucida.
Rosa Virginina.
Rosa rugosa.
Salix lucida.
Sand Cherry or Dwarf Cherry, (Prunus pumila).
Siberian Crab, (Pyrus baccata).
Scarlet Thorn, (Crataegus coccinea).
Snowberry, (Symphoricarpus racemosus).
Thorn, common, (Crataegus Crus-galli).
Walnut, Japanese, (Juglans Sieboldiana).
Willow, (Salix, sp.).
Willow, Laurel-leaved, (Salix pentandra).
Willow, Prairie, (Salix humilis).
Willow, Weeping, (Salix Babylonica).
Willow, Yellow, (Salix vitellina).

Hardy Trees, Shrubs and Vines, Occasionally or Rarely Infested.

Actindia arguta.
Alder, (Alnus, sp.).
Althea, (Hibicus Syriacus).
Arborvitæ, (Thuya occidentalis).
Ash, (Fraxinus, sp.).
Ash, White, (Fraxinus Americana).
Birch, (Betula, sp.).
Birch, Cut-leaved or White, (Betula alba).
Blackberry, common, (Rubus nigrobaccus).
Box, (Buxus, sp.).
Catalpa, common, (Catalpa bignonioides).
Cherry, Sour, (Prunus cerasus).
Chestnut, (Castanea Americana).
Chestnut, Horse, (Aesculus Hippocastaneum).
Cornus alternifolia.
Cornus Amomum.
Cornus candidissima.
Cornus circinata.
Cornus stolonifera.
Deutzia, (Deutzia, sp.).
Dewberry, (Rubus villosus).
Dogwood, Flowering, (Cornus Florida).
Eleagnus, (Eleagnus, sp.).
Elder, (Sambucus, sp.).
Eucalyptus, (Eucalyptus, sp.).
Euonymus, sp.
Fig, (Ficus Carica).
Forsythia, sp.
Globe Flower or Japanese Rose, (Kernia Japonica).
Grape, (Vitus, sp.).
Hackberry, (Celtis occidentalis).
Honeysuckle, (Lonicera, sp.).
Japanese Magnolia, (Cercidiphyllum Japonicum).
Jersey Tea, (Ceanothus Americana).
Laurel, Mountain, (Kalmia latifolia).
Locust, (Robinia, sp.).
Locust, Honey, (Gleditschia Triacanthos).
Maple, (Acer, sp.).
Maple, Norwal, (Acer platanoides).
Maple, Sugar, (Acer saccharinum).
Maple, Weir's Cut-leaved, (Acer sacc.).
Mulberry, (Morus, sp.).
Mulberry, Weeping, (Morus, sp.).
Ninebark, (Physocarpus opulifolius).
Orange, (Citrus Aurantium).
Pecan, (Hicoria Pecan).
Persimmon, (Diaspyros Virginiana).
Phqtinia villosa.
Privet, California, (Ligustrum ovolifolium).
Raspberry, Red, (Rubus strigosus).
Rhodotypos kerrioides.
Sassafras, (Sassafras officinale).
Smoke Bush, (Rhus cotinus).
Sorbaria sorbifolia, (spiraea sorbifolia).
Spiraea, (Spiraea, sp.).
Spruce, White, (Picea alba.).
Sumac, (Rhus, sp.).
Silver Thorn, (Elaegnus longipes).
Virginia Creeper, (Ampelopsis quinquefolia).
Viburnum, sp.
Walnut, Black, (Juglans nigra).
Walnut, English or Persian, (Juglans regia).
White Rod, or Appalachian Tea, (Viburnum cassinoides).

5. Description and Life History of the San José Scale.

During the winter the living San José Scale insect is a minute, soft, lemon-yellow object or insect, concealed beneath a very minute black, flat-conical protecting scale, which is waterproof, and which is recognized in examination under a microscope by its distinguishing circular shape and black tip at the exact center, with a very small ring around this point in the winter. It is about three-fourths grown and remains in this condition until the warm weather of spring comes, when the insect injects more poison into the growing layer of the tree or shrub and sucks sap for its nourishment. It grows and its scale enlarges to nearly the size of a pin head and becomes of a brownish color rather than black, as in winter time.

From the 10th to the 15th of June the first young San José Scale insects appear. To the unaided eye they look like the most minute specks of yellow corn meal, but under a microscope they are seen to be oval in shape and have six legs and a pair of antennæ, as have other insects. They crawl about on the bark and leaves or fruit rather rapidly for such minute creatures, and may migrate for a distance of several feet from the parent that gave them birth, or they may fix very near her, even overlapping her shell. They exist in this young and freemoving stage only one or two days, or long enough to find a suitable place to sink their long whip-lash tongue or proboscis through the outer bark into the cambium or growing layer, or often into leaves or green fruit, when they commence to secrete a waxy covering, which comes through the pores of their skin. At first this is white, and perfectly circular, with the characteristic little central point. This is their second stage or first fixed stage, and they are now known as "white points." In this stage while not nearly as delicate and easily killed as they were when young and free-moving, they are yet more tender than at any later time. They inject poison into the part of the plant where they are fixed, suck out the modified sap and grow, but can never again free themselves from this place, nor at any time let loose and move to another place, nor be scraped off and live. In the course of a few weeks they reach the third or black stage described above as "the winter resting condition," and continue to grow until they attain the full size and brownish color of the adult scale, which is in about a month or less, when they soon commence to bear living young and continue this at the rate of several per day for another month or more. This kind of life history is continued until about the first of December. We have seen the free-moving young on fruit trees in orchards of this State as late as the fifth of December. During the winter those die which are not old enough to reach the properly protected resting stage, and also all of the old or full

grown individuals die then. Consequently, each winter as many as fifty per cent. may naturally be found dead upon a tree, but this does not indicate that severe weather is destroying any unusual number of them, nor does it show any gratifying decrease of these pests. Their multiplication is so rapid that it is estimated (U. S. Bulletin No. 3, page 44) to be possible for an individual to become the ancestor of 3,216,080,400 in one season. Since they multiply so rapidly, any agency or insecticide that would leave five per cent. of them alive upon the trees would be decidedly ineffective in holding them in check.

The males of the San José Scale are smaller than the female and undergo complete metamorphosis or become winged in the fall.

They then occur as exceedingly small, two-winged insects. The young insect may live and develop for about thirty days, more or less according to temperature, before it commences to bear young, but the process of reproduction is so rapid that in one season one individual may become the ancestor of over three billion. Thus it is to be seen that this pest differs from the Oyster-shell and Scurfy scale and some other species of scale insects in the fact that it bears living young, while they lay eggs.

While the young scale insects are active they are, of course, unprotected, and are very delicate and easily killed. This was explained in detail in our June Bulletin for this year, Vol. IV, No. 2. Mild contact insecticides, such as dilute soap solutions, tobacco decoctions, oil emulsions, etc., which are used for plant lice will also kill the young scale insects, but will not kill the adult or parent that is treated at the same time with the same material. Our experiments have shown that it takes twelve or fourteen applications of contact insecticides at intervals of two or three days each to kill all the young scale insects as they appear and to exhaust the reproductive capacity of the parent. The mature insect is covered by a thinner scale during the summer time, and thus is less protected and more easily killed than in the winter. We have tried repeated experiments with all kinds of insecticides, and have found nothing that will kill the adult or mature San José Scale while the green leaves are on the trees without also destroying the foliage. Of course, plants that are not bearing fruit may be treated with an insecticide so strong as to kill the scale insects, even though the leaves be taken off, but this could not be done every year as it would soon result in the destruction of the plant.

Reproduction is continued until very cold weather, but the young that are born late in the fall die during the winter. When a tree has become so badly infested that it dies, its scale pests die with it. Also, when infested branches are trimmed from trees the San José Scales that are fixed upon these branches die as soon as the

sap ceases to flow, and there is not the same necessity for burning these at once as there is for burning branches infected with fire blight or twig blight from which the disease germs are likely to spread at any time.

6. How and When Carried or Spread.

The methods of disseminating or carrying this insect from place to place should be understood by all persons who are growing trees or shrubbery. In order to get these points clearly in mind it is necessary to understand the life history of this pest as given in the previous section of this article (see No. 5.) It should be kept in mind that the insect is able to move of its own accord only during the first day or two of its life, and it then fixes or fastens itself to bark, leaf or green fruit, and after a scale insect is once fixed it can never free itself nor move to another point. Thus it can be understood that the fixed or adult San José Scale is never carried or spread in such a way that it will live in its new quarters excepting when it is on wood that is going to grow again. In other words, the scale, when old enough to be fixed, is carried from place to place only upon plants that are to be transplanted or upon cuttings, buds, scions or grafts.

While the scale will be found upon ripe fruits it does not feed upon fruits after they commence to ripen, and hence does not multiply on them and is not spread while upon fruits that are ripe. It is perfectly safe to ship from one part of the country to another any fruits that are infested without the least fear of danger in disseminating this pest, because it cannot free itself from the green fruits upon which it is fixed and does not live upon ripe fruit. After years of experiments with infested fruits of all kinds obtainable, we are prepared to say that we have never been able to obtain young scale insects from parents that were upon fruits which were commencing to ripen or mature. This shows the injustice of the laws of some of the European countries which attempt to prevent the introduction of the San José Scale there by the prohibition of the importation and sale of American fruits if infested and the confiscation and destruction of all shipments of fruits which have among them even a very few specimens of this scale insect. Such laws are but useless restrictions, as they are evidently based upon ignorance of the fact that the scale can not be carried into any country by such means.

After an infested tree is once planted in an orchard it is solely in the young or free-moving state this pest passes or is carried from tree to tree, unless infested cuttings, such as buds or grafts, be used. To prevent its spread upon such cuttings these should be placed in a vessel that can be tightly closed, like a wash boiler, and

fumigated with Hydrocyanic Acid Gas or Carbon Bisulphide. The means of carrying the young insects are various, as they are known to be transported by any agency that will bear them from one tree to another. Chief among these agencies are birds, upon the feet of which the young insects may crawl and be carried to a distant tree. Proof of this is found in the facts that frequently the infestation starts in that part of the tree where a bird's nest is found, and that the pest is more uniformly and extensively distributed where certain birds, such as the English Sparrow, are most abundant. Some persons have used this as an argument against the American Robin, but such reasoning is not proper because the young scale is liable to be carried upon the feet of any kind of bird that will alight upon an infested branch, and it is also carried in a great many other ways besides by birds. Thus, if all the robins in the State were destroyed it could not perceptibly lessen or check the spread of the San José Scale.

This pest, when young, is also carried upon larger insects, such as grasshoppers, June bugs, and other beetles, flies, bees, etc., upon which it may crawl. A large and varied collection has been made of insects of larger size upon which this little pest has been actually found at the time of collection. It is also carried from tree to tree by squirrels, cats and other animals that may climb an infested tree and get the young free-moving scales upon their feet or fur and subsequently climb an uninfested tree and leave the pests there. They have also been carried upon the clothing of workmen passing from tree to tree, and also upon larger animals such as horses and cattle that walk beneath the infested trees and receive the pests dropping upon them and later accidentally brush them on other low branches. These pests when in the young state are also carried by the wind upon leaves or twigs that may be broken off, especially during storms, and we have positive evidence that they are disseminated by the wind in the fact that we have often found infested trees on the leeward side of one that originally had the scale, while on the windward side they were free from it. During the past year this feature was especially noticed on nursery stock grown in the vicinity of older fruit trees that were infested. The San José Scale is undoubtedly carried short distances through the air during the time it is young and free-moving, just as grains of dust or sand are carried, but not to the great distances that are sometimes believed.

Where the branches of trees intertwine it is possible for the San José Scale to crawl from one tree to another, and it often does this. Grape vines running over varieties of trees that are liable to be badly infested, such as peach, plum, pear and apple, are often found killed by the San José Scale, while they would not be seriously at-

tacked if away from such trees where the young pests could not freely crawl to the vines. There is absolutely no danger of the young San José Scale crawling down the tree and over the ground to other trees, because their tendency is to stay on the living wood or seek at once a bare spot where they can find a suitable place to fix, feed and live. Their occurrence upon the feet of birds is the result of short and accidental journeys rather than long and apparently premeditated migrations.

7. Why is the San José Scale so Destructive?

The following are some of the reasons why the San José Scale is so much more destructive than any other of the dozens of species of scale insects found in this State:

(1) It injects the most deadly poison into the trees. Its presence on young peach bark and fruits of nearly all kinds is generally shown by a large red blotch surrounding each scale and indicating the injected poison. By scraping off the outer bark of an infested pear limb the red blotches caused by this severe poison are plainly seen in the green bark and wood.

(2) It is so small (our smallest scale insect) that its presence is often not suspected until its fatal effects are seen in the dying trees. It is then too late for any but the most radical remedies, intelligently and properly applied.

(3) It multiplies so rapidly that it soon covers a tree and spreads readily to others. According to the publications of the U. S. Department of Agriculture one of these pests may become the ancestor of as many as three billion two hundred and sixteen million (3,216,000,000) in one season. Other common scale insects such as the Oyster-shell or Scurfy do not produce more than 600 descendants in a single season.

(5) Its ability to feed on many kinds of woody plants (not all species) makes it possible for it to spread more rapidly over a wide area, by being carried from one kind of tree or shrub to another, just as fire spreads only where there is combustible material.

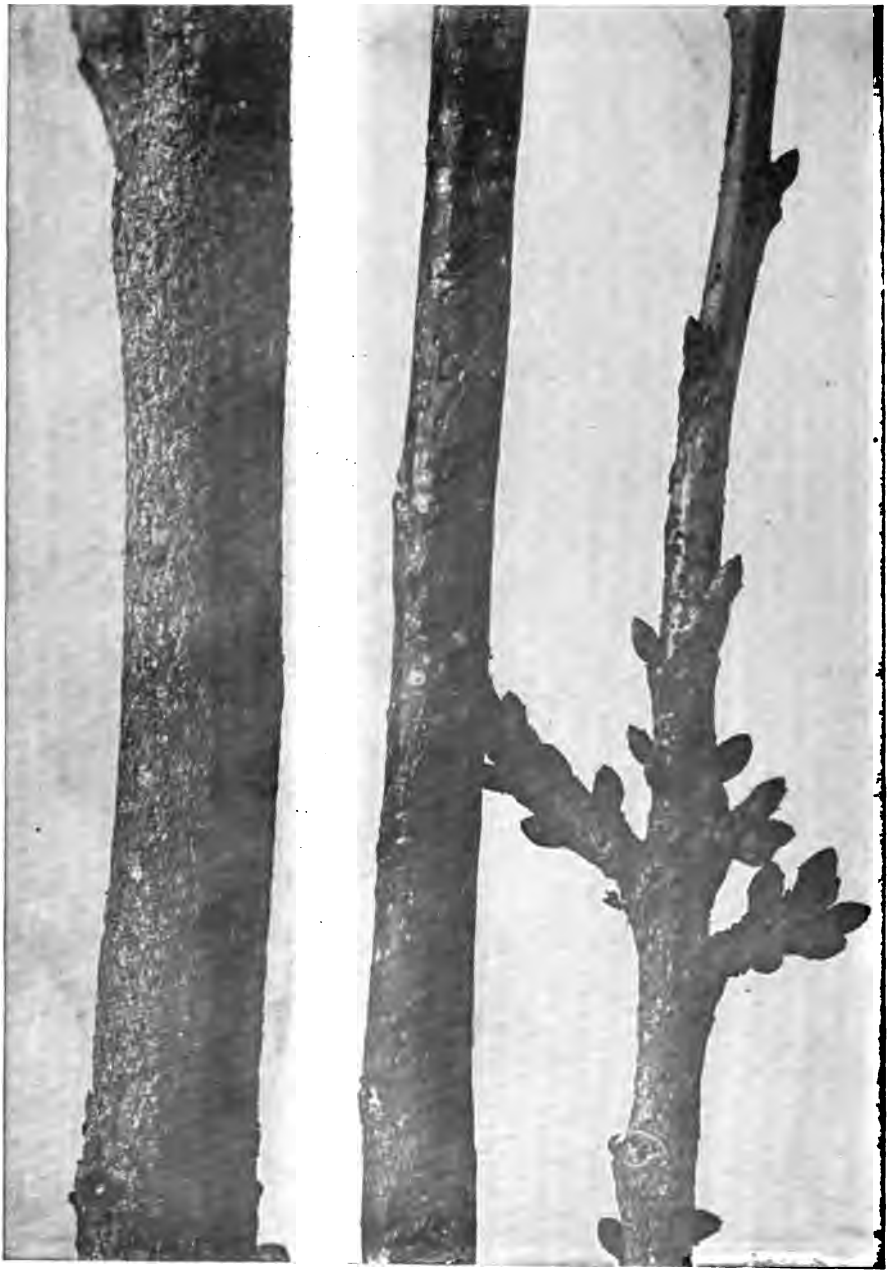
(6) It multiplies by bearing young instead of laying eggs (as do most other species of scale insects), and as these do not appear at one time or in one brood and of one age, but at intervals of a few hours between each during the entire season, from June to December and they spread by natural agencies only when young and free-moving (during their first two days) the San José Scale consequently spreads by natural means during nearly six months. However, the others, such as the Oyster-shell Scale and Scurfy Scale, which lay eggs and hatch at one time, appear in broods and there are thus only a few days during each year when they are young and free-

Fig. 1.—San Jose Scale (*Aspidiotus perniciosus*) on branch of Apple, natural size. On piece of bark at left, above, are magnified specimens. (*By Howard, in Circular of Div. of Ent., U. S. Dept. Agr.*)

a *b*

Fig. 2.—a, San Jose Scale on Pear Twig, natural size; b, San Jose Scale, greatly enlarged, showing the crawling young and the different ages of the insect in the fixed stage. This shows just what can be seen with a good microscope on badly infested trees during the entire summer, after about the tenth of June. (From *Howard and Marlatt, in Bull. of Div. of Ent. U. S Dept. of Agr.*)

PLATE XLV.

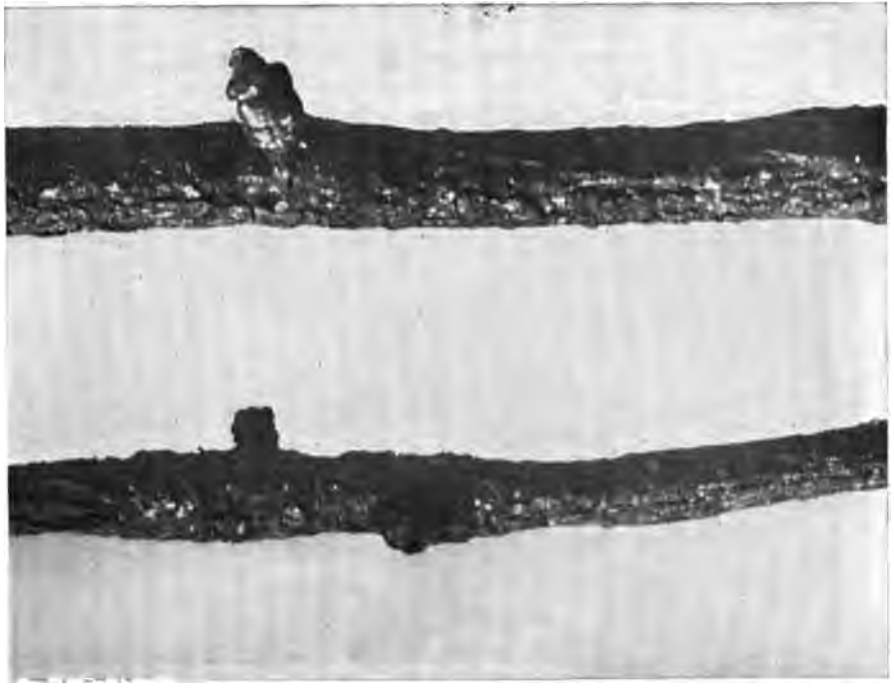


a b c

FRUIT TREE BRANCHES WITH SAN JOSE SCALE.

a. Scale in Winter Resting Stage.
b. Full grown or Adult Females.
c. Scale in Winter Stage, on Sweet Cherry.
All Natural Size.
Photograph of Specimens in the Office of the Economic Zoologist.

PLATE XLVI.



Pear and Apple Branches Infested with living San José **Scale, but injured by oil. Note the** cracked bark just below the side **spur in each.**
Photographed, natural size, from Specimens collected in **Dr. Groff's Orchard at Lewisburg, Pa., by the writer, H. A. S.**

PLATE XLVII.

Tree Showing Incorrect Methods of Pruning and Spraying. Terminal twigs clipped off last year made bunchy growth later. Left side well sprayed, with the wind. Right side poorly sprayed, against the wind.
Photographed in Orchard near Harrisburg, Pa.

PLATE XLVIII.

moving, and at which time they are spread from tree to tree by the agencies that carry them.

(7) They are so small that they are not large enough to nourish and sustain the same kinds of destructive internal parasites that hold in check nearly all other species of scale insects.

(8) They have been imported into this country without their natural enemies, and we have no insects or other creatures that feed upon them to a sufficient extent to prevent their exceedingly rapid increase and spread.

(9) The native home of the San José Scale is the northern part of China, which is naturally a cold country in the winter time, and as a consequence this pest is able to endure our severe winter weather without having its numbers greatly reduced by freezing.

(10) The San José Scale is so hard to kill by insecticides that these materials must be strong enough to seriously injure the foliage of trees in order to kill the old or fixed scales, and for this reason they must be treated when the trees are dormant and not in leaf and can not be suppressed by spraying while leaves are present as can many other species of insects. While spring spraying in May will kill the Oyster-shell and the Scurfy Scales because they are then all in the young and delicate stage and easily killed by mild contact insecticides, such as Whale Oil Soap in water, or Kerosene Emulsion, dilute, the San José Scale insects are to be found in all possible stages of development at all times of year after the appearance of the first young in the early part of June. Therefore, the spraying that will kill them in the young stage would not destroy all the San José Scale, because there are living old ones at the same time which would not be injured by the same material.

8. Natural Enemies of San José Scale.

Most other scale insects in this country are held in check by very minute, wasp-like parasites, which lay their eggs in or on the pests and whose larvæ or young feed in the bodies of the scale insects, resulting in the death of the host. It is not uncommon to find the external coverings or shells of the Oyster-shell, Scurfy and Turtle-shell or Lecanium Scales punctured with many holes, showing where these internal parasites have escaped, yet the San José Scale is so very small that the parasites can not find in it enough substance to bring their larvæ to maturity and most of them pass it by without attempting to lay eggs in it.

The chief external parasite or insect which devours the San José Scale is the Lady Beetle. There are a great many beneficial species of this particular family in this country, but they do not appear to have developed a special appetite for the Asiatic foreigner. Pro-

fessor Marlatt, of the United States Department of Agriculture, at Washington, went to Asia and procured and introduced into this country living specimens of one species of Lady Beetle, upon the efficiency of which high hopes were vainly based by many fruit-growers. Specimens were kept, multiplied, and were disseminated from Washington, D. C., but there is probably not one of these introduced colonies in existence to-day. Certain parasites in this country, and severe weather, combined to kill the beneficial Asiatic Lady Beetles by which fruit-growers were hoping for relief from their most dreaded foe. There is now nothing but the spray pump toward which we are justified in looking to save our property from destruction by the San José Scale.

9. Can it be Controlled?

We are frequently asked if the San José Scale can be exterminated, and we say, "No, but it can be controlled to such an extent that the very finest fruits can be produced upon trees where it has been existing for years, or shrubbery can be kept vigorous and in nice condition, notwithstanding its presence." In making this statement we have in mind the difference between entirely exterminating a pest, or in other words wiping it out of existence as a whole, or merely controlling it or suppressing it to such an extent that it does not appear in destructive numbers. As far as practical purposes are concerned, the control of pests is, in its immediate results, fully as satisfactory as entire extermination. The chief difference lies in the fact that when pests are exterminated, practical measures against them need not be repeated annually nor at regular intervals, but when they are merely controlled, the means of control or check must be applied more or less frequently or regularly, and if it be neglected they will again increase in such numbers as to prove overwhelmingly destructive. This indicates exactly our view of the San José Scale in Pennsylvania. We know where many fruit growers and farmers have controlled it to such an extent that they no longer fear its ravages in the least, and have this year produced as fine crops of fruit on trees that were previously badly infested as could be produced on any trees in the country. They are consequently satisfied with controlling the San José Scale alone and are not worrying about the impossibility of extermination. We are certain we would be misleading the public if we should say it is possible to exterminate the San José Scale in this State, even with an annual expenditure of millions of dollars and the employment of hundreds of men. However, it is certainly possible to help our citizens save their property in a satisfactory manner by an annual appropriation not amounting to one per cent. of the loss that would be sustained if such work were not done.

The spray pump has come to be an essential feature of every farm and orchard. Its use must be as familiar to the agricultural people as is that of the plow or reaper. In fact, our successful fruit growers, who have this year sold thousands of dollars worth of fruit, will say at once that the most valuable piece of apparatus which they possess is the best spray pump they have used. It can be employed successfully against nearly all plant diseases as well as against most insect pests. By its intelligent use such insects as the San José Scale will be effectually and satisfactorily controlled and the infested trees or shrubs will be left in even better condition than though they had not been attacked and sprayed. This is because the Lime-sulphur Wash, which is now generally acknowledged as the best and cheapest remedy, is a fungicide as well as insecticide and also destroys the plant disease germs, which are upon the tree at the time of application. The spray pump as a means of controlling the San José Scale and other insect pests and many plant diseases is as necessary in the hands of the intelligent fruit grower as are lines in the hands of an intelligent driver for controlling and guiding a horse. Let fruit growers take heed and faithfully follow the directions outlined in this Bulletin, and if they need help write detailed questions to this office and receive the assistance which we are willing to give without charge.

10. Remedies.

A great many different kinds of material are suggested as remedies for the San José Scale and many of these have more or less merit. However, to be satisfactory, it should have the following qualities: (a) Effectiveness in killing the scale. (b) Freedom of injury to the trees. (c) Cheapness as to cost and method of application. (d) Ease of preparation and application. These qualifications are mentioned in order of their importance. It must be acknowledged that no insecticide is known that is ideal in each of these four features, as far as can be proven by experiment or actual tests that have already been made. No tree grower is justified in using any newly devised material before it has been fully tested. We discuss below some of the common insecticides in regard to the qualifications named above.

There are only three general methods of successfully treating trees or shrubs infested with San José Scale to destroy the pest without killing the trees. These are as follows: (a) Washing or painting; (b) Fumigating; (c) Spraying. It is to be observed that all of these are processes of contact applications, or remedies that must be applied externally, because the insects are suctorial. Internal applications or poisons such as Paris green and other arsenites, will have no effect whatever upon the San José Scale, be-

as is used for sprinkling plants or washing carriages. While this may throw a stream it will not make a spray, and consequently will not have the desired results, because it can not be made to cover all the bark, especially of twigs, and also waste much material.

In a spray the liquid is so finely divided that it is in the form of small particles like water-dust or mist and can not be thrown against the wind. For this reason when the wind is blowing it is necessary to spray one side of the tree toward which the spray is carried and leave the opposite side to spray at any time in the future before the buds burst but after the wind has changed to a favorable direction. It is best to spray the trees from four different directions in order to have the liquid applied entirely to all branches and twigs to the very tips.

How to Spray.—In preparing to treat very small trees or bushes it is best to have one man operate the spray pump and another hold the extension rod, carrying the nozzles. Commence to spray the top of the branches and carry the nozzle toward the interior of the tree following each branch. Then turn the extension rod in such a way that the bend or quarter-turn will make the nozzle point toward the branch in a slightly different direction, and spray from that side. Then turn the spray to the opposite side by using a rod with a bend toward the end or an eighth-turn or quarter-turn attachment. Many branches and the trunk itself can be sprayed from practically three sides merely by turning the extension rod over and without the operator changing his position. After the top has been well sprayed, turn the nozzle upon the trunk and spray that from every side, so that it will be well covered clear to the ground. No injury comes from enough material being used to run down into the soil, and this may be a decided benefit to peach and plum trees, as it can thus be used to kill the borers.

For trees with low branches it is necessary to keep the apparatus low enough to pass under the branches or to drive between the trees. Where the branches are low and the trees close together, the tower or elevated platform cannot be used, but where there is room it is quite desirable to construct an elevated platform or tower, and have one operator stand on this. Time is saved by using a pump strong enough to carry two leads of hose. Thus one man operating the pump handle can give pressure or power for two sprayers, each holding an extension rod with two or three nozzles. With such equipment a tree can be sprayed in only a few minutes.

Completely encrusting all parts is necessary when using any of the lime mixtures. To neglect to spray all twigs to the tip with any material, means to leave a great many living insects on them, and thus have the tree reinfested by the descendants of these before the end of the growing season this summer.

When to Spray.—The time to spray depends in part upon the number of trees that one may have that need spraying and the amount of apparatus which he may have to do the work, or in other words the time that it would take to complete the job. Our experiments have proven conclusively that the best possible time of the year to spray is in the spring just before the buds burst, especially when using the Lime-sulphur combination, as this stays on the trees better when applied at such time, and has a desirable effect in keeping the young scale insects from fixing. However, a person should commence his spraying early enough to be sure to finish it before the leaves are out. Also there is danger of enforced loss of time by intervening bad weather, and the spraying should be begun in time to make due allowance for this. If the orchard be large it is advisable to spray the worst parts in the fall, or better, spray in the fall and again in the spring.

What to Spray.—All trees and shrubs liable to be infested with San José Scale should be sprayed when they are known or supposed to be so attacked. It is not necessary to spray them if they be entirely free from scale. However, in a vicinity where the scale is common it may be taken for granted that all fruit trees are infested, and they should, therefore, be treated to save them before the pests become so numerous upon them. If, for example, there be only a few infested trees or shrubs upon the premises it is quite desirable to spray all that are of varieties attacked with scale listed on a previous page, because although there might be only a few specimens of San José Scale upon each tree at that time, and these could not be found even by a careful search, they would multiply to such an extent within a year as to justify the spraying now to kill them.

It is not at all wise to spray only trees that are visibly infested here and there over an orchard and leave the others untreated. If there be a scattered infestation on the premises there should be a general spraying. However, it is not necessary to spray maple, elm, walnut, hickory, ash and other forest and shade trees. Look over the two lists given in preceding pages, and if your ornamental trees and shrubbery be not given in those lists, it is not necessary to spray them, even though they be standing near other trees having San José Scale. Of course, old fruit trees are liable to be infested, as well as young, and when this is the case they should be sprayed soon, because after such trees are badly injured they are not liable to regain their vigor and usefulness.

(d.) With What to Spray.—Materials or Insecticides.

The three general groups of insecticides which can be used successfully for control of the San José Scale are as follows:

I. The Lime-sulphur Compound. II. Oils in some form. III.

Soap Solutions. If used in proper proportion and in the correct manner any one of these can be made to give good results.

The kind of material to use depends in part upon conditions, such as the kind of trees or shrubs to be treated, their size, age and condition of insect injury. Where a person has but a few trees in a lot upon a lawn, he can afford to give them much more time and care individually than though he had to treat several thousand trees in an extensive orchard, but at the same time he cannot afford the large or expensive apparatus necessary for doing thorough spraying upon large trees, neither can he afford the time and trouble to make and apply the best known remedy—the boiled Lime-sulphur Wash.

I. THE LIME-AND-SULPHUR COMPOUNDS.

The best and cheapest materials for controlling the San José Scale, and also acting as fungicides to rid the trees of certain diseases which would otherwise attack them in the spring and summer, are the Lime-sulphur compounds made by heating Lime and Sulphur together until they form a new chemical substance, which is much different from either and has a greater chemical action than either alone. The best of these, because the cheapest, is the boiled Lime-sulphur Wash. There are a great many variations of the Lime and Sulphur Formulæ, but these variations are not important. As a general rule, it is better to use a few pounds more Lime than Sulphur just to meet the condition that the Lime is not pure while the Sulphur is. This makes up for the probable amount of impurity in the Lime. However, it is not necessary nor desirable to use twice as much Lime as Sulphur, as it makes an additional amount of the substance that clogs the nozzle without increased benefits.

(a) The Lime-Sulphur Wash.

The most common formula for this wash is as follows:

Lime, 22 lbs.
Flowers of Sulphur, 17 lbs.
Water, 50 gals.

Put the Lime and Sulphur together, and use enough water to boil. Boil one hour, strain, and add enough water to make the fifty gallons required in the formula.

In regard to efficiency in killing the scale, beneficial results on trees, ease of obtaining material, and cheapness of original cost, there is no insecticide that can equal the boiled Lime-sulphur Wash. The only thing that can be said against it is the trouble in making

and applying it, which is not great when the operator knows how to do it.

It is slightly troublesome to make but it has great advantages. Among these are the following: The exact proportions are not necessary. If a person should get a little too much or too little of any one ingredient he does not injure the efficiency of the Wash in killing the scale nor will he thereby inflict any injury upon his trees. There is no possible danger of applying too much of this material to any kind of tree, as in using the oils, which have been unduly advertised and applied with such disastrous results. No special apparatus of any unusual make is necessary in either making or applying this material. It can be applied at any time of year when the trees are not in leaf. By its white coating the operator can readily see what spots may have been missed and can thus be sure of the chance to retouch them, and the person who engages another to spray his trees can see for himself if the work has been thoroughly and properly done. It is a fungicide as well as an insecticide and cleans up many of the disease germs, such as those causing leaf curl, ripe rot, leaf spots, rusts, smuts, mildews, bitter rot, apple scab, pear crack, black rot, and other diseases of leaves or fruits. It is not injurious in any proportion nor any amount upon any kind of tree even of the most delicate varieties. It is very cheaply made, costing but a little over a cent per gallon when dilute and ready to apply to the trees. Of no other known insecticide can the above statements truly be made. We unhesitatingly recommend it as absolutely the best, cheapest and safest remedy for controlling the San José Scale, and the slight trouble in making it is reduced to insignificance if the operator be provided with apparatus even no more complicated than two or three iron kettles set into a rough furnace or protected by stone walls along each side to retain the heat and keep the wind from blowing the flames away.

In general, the method of getting the lime-sulphur and salt together before boiling is not at all essential. Neither is the kind of vessel in which it is to be boiled. We have had equally good results with common iron kettles standing or suspended over open fires, common galvanized iron wash tubs on two walls of stone, box-shaped vats of sheet iron built for the purpose, furnaces constructed for boiling, and even kettles and boilers upon kitchen stoves. However a copper kettle should not be used, as the chemicals will readily combine with the copper and ruin the vessel. We generally put the lime into the vessel in which it is to boil, sprinkle part (perhaps half) of the sulphur over it, pour on enough hot water to start it to slaking well but not to drown it, add the remainder of the sulphur and more hot water in a short time, stir the mass well

together, add enough water, hot or cold, to make it thin enough to boil well, stir to the bottom occasionally, bring it to the boiling point and boil for at least three-quarters of an hour after it reaches this point. Many persons will say that they can get the red color by less boiling, but while this is true we do not think they can get the entire combination necessary for the best results within less than three-quarters of an hour from the time boiling commences. After boiling use cold water to dilute to the full amount required in the formula.

If the mixture is to stand for some time crystallization can be prevented by diluting it while it is yet warm. In this event, however, it should be again placed over the fire and heated before being put in the spray tank for the purpose of making it thinner and putting it through the nozzles in the best manner. If it be not diluted before cooling it can be prepared when wanted by diluting with hot water or skimming out the crystals and boiling them until dissolved and using this solution for diluting.

Where much material is needed it is advisable either to construct special tanks or vats for boiling on an extensive scale or to use live steam from an engine, conveyed by means of a pipe extending to near the bottom of the barrel of liquid to be boiled. By this means one can boil it in wooden tanks or barrels, and it is even possible by means of live steam to boil it in the tank from which it is to be sprayed, but in this case a basket-shaped, fine wire strainer should be arranged around the entrance to the spray pump. Often steam may be obtained by means of a threshing engine or stationary steam engine, especially such as a small engine at a creamery, and many persons may find it advisable to arrange to have their material boiled in this way. Such boiling has the advantage of doing away with the expense and trouble of kettles, and the work of stirring occasionally while boiling to keep from sticking to the bottom.

Where steam is to be had, as from a house heated by furnace steam, greenhouse, creamery, threshing, or other engine, it is an excellent plan to extend the horizontal pipe over a row of barrels and into each of these extend a vertical pipe almost to the bottom and boil the material by live steam. This, of course, can be boiled in barrels and does not necessitate stirring. It should boil fully one hour from the time real boiling commences.

The results with the lime and sulphur washes have shown that they are fungicides or preventives of such plant diseases as leaf curl of peach, brown rot of peach and plum, leaf spot, rusts, smuts, bitter rot of fruits, apple scab, pear leaf blister, etc. For this reason some of our best fruit growers say they will spray with this wash every spring shortly before their buds burst, even though they may not have much San José Scale.

It does not make any difference how the materials are added to the water before boiling, but it is best to slake the lime with enough water to slake it, but not drown it, and stir the sulphur into a paste, with enough water to make it mushy and add this at any time and add enough water to let it boil, stirring occasionally to keep it from burning the bottom. The boiling is absolutely necessary as good results can not possibly come without it. By means of the heat a new mixture is made that is not sulphur, nor is it lime, nor is it a mixture of the two, but it is composed of several compounds of lime and sulphur, and they differ as much from the original material as water differs from its two elementary components, hydrogen and oxygen. The new compounds are very caustic and are liable gradually to eat through the skin of the hands of careless operators or even to take the hair off of horses if they be not properly blanketed. By proper straining to prevent clogging the nozzles, covering the hands with vaseline or melted tallow, wearing gloves soaked in melted tallow, and a large handkerchief or cloth around the neck, spraying only with the wind, and keeping the horses blanketed and out of the spray, this material can be applied with perfect safety and without much trouble or offense to operators. It is no worse in this regard than is crude petroleum or whale oil soap, and does not stink as badly as either.

We are occasionally asked if a "Self-boiled" Lime and Sulphur made by merely the heat of the lime will give satisfactory results. It certainly will not, any more than will beans that have been boiled only five minutes be fit for human food. After boiling it is not necessary to dilute with hot water as cold water will do just as well for diluting purposes. It is not the heat that kills the scales yet we apply it warm (not boiling hot) because it runs better through the nozzles and makes a better spray while warm than when cold and thick. It is better to keep it warm from the time it is made until it is used to prevent the formation of bothersome crystals, but if this be impossible it should at least be diluted before permitting it to stand and get cold. The best way is to not make more in one day than is to be used that day, although we know where it has been made and shipped successfully for use at another place. In our experiments to determine how long it can be kept and at the same time be efficient, we have learned that it can be kept for months and heated and used with good results.

The Salt.—The salt is not absolutely necessary as an ingredient in this mixture, but it probably increases the adhering power or makes it stick better to the bark, and it certainly makes the solution more condensed and considerably raises the temperature at which boiling takes place, and consequently may give a higher heat and more perfect union of the lime and sulphur. However, it is more

liable to rust the apparatus and wear the nozzle, and also it is more liable to be injurious to the sprayed trees, especially tender peach twigs in the fall. We have never seen any evil results in regard to injury of treated trees or shrubs from spraying with the Lime-sulphur-salt Wash, excepting when the Lime-sulphur-salt combination was used and sprayed on tender peach twigs in the fall. In a few orchards the smaller branches were killed by this treatment last fall, and in one orchard where we sprayed both in the fall and in spring, the latter spraying did not result in any injury to the trees while the effects of fall spraying were quite serious.

Our experiments have proven conclusively that the scale is killed quite as certainly without the Salt being added to the boiled mixture as when it is used. Its use slightly increases the expense of the material and the trouble in preparing it, and consequently we advocate omitting it entirely. In this we are supported by other entomologists and zoologists from various Experiment Stations of America. (See the Summary from Prof. Smith's Georgia publication to be given in December Bulletin.)

The Sulphur.—It is essential for the sulphur to be powdered, as we have tried the roll or stick sulphur (brimstone) without satisfactory results. Flour of sulphur is that which has been melted into cakes and then ground. Although it is a dust it is not as finely divided as the flowers of sulphur, which is deposited by sublimation, or heating and driving against a cool surface, just as soot or lamp black is deposited upon the lamp chimney by smoke. This is yet more finely divided than the flour of sulphur, and for this reason we recommend the flowers, as the union with the lime will take place sooner and perhaps more completely, although by a little longer boiling the flour can certainly be made to do as well. From the wholesale dealers the flowers of sulphur cost but twenty cents per hundred pounds more than the flour of sulphur, and this difference of expense should not be enough to justify using that form which is liable to give less satisfactory results.

Flour of Sulphur can be purchased at about $2.40 per hundred in barrel lots loaded on board the cars, or the Flowers about $2.60 per hundred pounds for barrel lots, also F. O. B., of such dealers as Powers-Weightman-Rosengarten, Philadelphia, Pa., The Thomsen Chemical Company, Baltimore, Md., and the Bergen Point Sulphur Works, Burling Slip, New York City. If there be other convenient manufacturers selling Sulphur wholesale from central points, especially anywhere in the State of Pennsylvania, we shall be glad to be informed of that fact and make proper announcement for the sake of persons who may wish to know where to buy from dealers near their homes, and consequently save freight. It should be remembered that the Flour of Sulphur is sold either in

sacks (100 pounds) or in barrels, with not less than three hundred pounds in a barrel, while the Flowers of Sulphur, which is the sublimated or more finely divided condition, is sold by wholesale only in barrels, but these barrels weigh only one hundred and fifty pounds. In boiling the Lime-sulphur Wash there is practically no difference in regard to the form of powdered Sulphur used, for both forms are pure Sulphur; but in making the Self-boiled Wash or Caustic Soda Wash, depending upon hot water and chemical action for the combination of the Lime and Sulphur, it is better to have the more finely divided form, known as Flowers of Sulphur, because it is necessary to have every possible factor in favor of making the most perfect union of the chemicals with very little heat.

To mix the Sulphur or add it to the mixture the best method is to put it in a vessel like an ordinary kettle or water bucket, and add enough water to make it possible to stir it into a paste or mush. Then add this wet paste of Sulphur to the mixture, and it will enter the water readily and not stay on top in little dry yellow lumps, as it does when the dry Sulphur is added to any mixture containing water. Sulphur can be kept many years without losing its beneficial qualities, and as it is useful in destroying other pests, especially parasites on fowls and live stock, it is well to buy it by the barrel and keep it on hand.

The Lime.—The lime should be the best possible quality of calcium to be obtained, and a grade which is as free as possible from sand or sediment. Where there is much sediment this can be determined by slaking some of the lime, and adding enough water to make a milky solution, stirring, permitting it to settle a few seconds, pouring off the milk of lime and examining the deposit at the bottom. If there be much sediment it will be better to slake the lime and make a milk of lime before boiling, and strain it before putting it into the vat or kettle in which it is to boil. At all times the mixture should be strained through a fine wire netting as it is poured into the tanks from which it is to be sprayed. It is important that the lime used should be oxide of calcium or true lime instead of oxide of magnesium or magnesium lime.

Many persons have noticed that sometimes in boiling the Lime and Sulphur together to make the Lime-sulphur Wash the color becomes brick red, or more exactly the color of cooked tomatoes and remains so, while at other times it first becomes dark red, but by a little further boiling turns to a dark olive green color. There is evidently a cause for this difference, and this is no doubt to be found in the difference in the chemical composition of the Lime. It has been and is yet the opinion of most persons that the red mixture is to be obtained only with Calcium Lime or Calcium Oxide, while the olive green color comes from the use of Magnesian Lime

or Oxide of Magnesium. We know that the latter is more mild in its action, and for this reason it may not have such decidedly killing effect upon the scale. We have previously directed operators to use the Calcium Lime, as we wish to be sure of best results. We have not been able to have chemical analyses made to confirm our suspicions in this regard, but we are now gratified to see that Prof. Smith, of Georgia, in a recent Bulletin on the San José Scale, endorses our view in regard to the Calcium Lime being more efficient than the Magnesia. (See Summary from the Georgia Bulletin to be published in the December Bulletin.) It is no doubt owing to the difference in the character of the Lime that the discussion arises from persons in different parts of the country as to how long the material should be boiled, as far as color becomes the criterion. Some say the length of time for boiling is until it becomes olive green, and others say that they find it impossible to do this, as it remains dark red. It certainly is not necessary to boil it longer than one hour of actual boiling, whether the color be green or red, but it is important to not stop the boiling as long as any light yellow sulphur can be stirred up from the bottom. Boil until this is all gone. Stir to the bottom occasionally, but it need not be stirred all the time.

To Keep Lime Fresh.—It is often necessary to buy quite a quantity of lime at one time and keep it in stock ready for use in the future. If kept dry or exposed to the air it will become air-slaked or undergoes a chemical change which results in a form of lime entirely different from that which is produced from slaking with water. The air-slaked lime is not suitable for making the lime-sulphur washes, and this may be one reason why persons who have used it have not had better results with the lime-sulphur-salt wash. Quick lime or fresh lime is always required, but this can be slaked when received and kept in a barrel or other vessel, under water, in the form of paste or putty. Keep it covered with an inch or more of water so that it will be wet all the time, and it is ready for use whenever needed. Dip out the amount required in any formula, making allowance for the added weight of the water in which it is mixed. This means three times as much of this putty of lime should be used as is required in a formula calling for unslaked lime.

The Strainer.—Nearly all firms making spraying apparatus now make and sell strainers especially adapted to strain such materials as the Lime-sulphur Wash. However, most of them are so constructed that they readily clog and give a great deal of trouble. There is no one feature of spraying with the Lime-sulphur Wash that is more disagreeable or annoying than the clogging of the nozzles. All who have sprayed with the Lime-sulphur Mixture will emphatically agree with us in this statement. Yet we have been

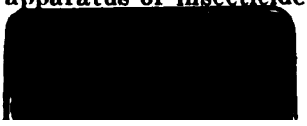
able to spray for one-half day at a time with material made according to the regular formula, without one clogged nozzle during that time. This is accomplished by cleaning out the kettles, barrels and spray tanks well, especially the interior of the tank and hose, so that no dirt will be in it before the mixture is added. Then strain the mixture properly and afterward keep the tank covered so that pieces of bark and other small particles can not fall into it from the tree under which it is drawn, and later find their way into the nozzles.

In straining, a piece of wire netting or cloth should be used, which has the wires at least as close together or as many as twenty-four to the inch. Window screening will not do for this. Gunnysack or Coffee Sack is quite poor material to use for straining. In fact, no cloth is suitable for this purpose. The lint or fibres are liable to be carried into the spray tank and readily clog the nozzle. In straining with cloth some threads are liable to be pushed aside and larger particles than are desired will crowd through them.

The best commercial or ready-made strainer that we have seen is one that has a large flat sheet of wire soldered across at an angle, in such a way that one side is much higher than the other. The liquid strains through this fairly well. The poorest metal strainer that can possible be used is the one that is merely a sheet of wire placed flat across a funnel, as most strainers are, and the best that we have ever used and which we are now placing in the hands of our demonstrators is made by our tinner, and consists of a cone of fine brass wire netting placed upright in a funnel in such a way that the base of the cone comes down inside the funnel, toward its lower part, and the apex or point of the cone stand up inside the middle of the funnel and is strengthened or supported by a few heavier wires or a very coarse wire netting (one-fourth inch mesh) fastened under it from the under or inner side. Through this conical strainer the Lime-sulphur Wash runs almost as freely as water, at the same time the straining is done very thorough. The sediment which comes from the material collects around the base of the cone but inside of the funnel in such a way that it can be thrown out or put back into the kettle for further boiling as may be desired. As far as we know this device is of our own origin, and not being patented is offered to the public as a great convenience in this work. (To be Concluded next Month.)

OUR INSPECTORS NOT AGENTS.

We take this opportunity to say that no person connected with this office is an agent for any trees, apparatus or insecticide of any



THE MONTHLY BULLETIN OF THE DIVISION OF ZOOLOGY FOR DECEMBER, 1906.

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THE SAN JOSE SCALE IN PENNSYLVANIA.

(Continued from the November Number.)

(a) The Lime-sulphur Wash. (See page 264.)

(b) The Lime-sulphur-salt Wash, or California Wash.

This is made in exactly the same way as Formula a, or the Lime-sulphur Wash, excepting that ten pounds of Salt are added to this material for each barrel lot at the time it is boiled. A few persons think they have better results with this formula, and there is certainly no objection to their using it if they desire, especially as a spring spray. Our experiments have shown some injury to peach twigs when used in the fall, and the salt causes the apparatus to rust worse and the nozzles to wear out faster.

(c) The Lime-sulphur-bluestone Wash, Oregon Mixture.

Fresh Lime, 22 lbs.
Powdered Sulphur, 17 lbs.
Bluestone or Copper Sulphate, 10 lbs. or less.
Water to make 50 gals.

This is to be made in just the same way as the Lime-sulphur Wash by boiling, and the Bluestone is to be added during the process. The purpose of the Copper Sulphate was to make the mixture act as a fungicide as well as an insecticide, but it has been determined that it is a fungicide without the necessity of the addition of the Copper Sulphate or Bluestone, and consequently this is a additional expense and troublesome feature that we do not consider essential. (This is discussed in full in our Bulletins of November and last February.)

(d) The Lime-Sulphur-Soda Wash, or Lime-Sulphur-[illegible]

Fresh lime, 22 pounds.
Sulphur, 17 pounds.
Caustic soda, washing soda, or lye, 4 or 5 pounds.
Water, 50 gallons.

This is recommended as a good lime-sulphur wash [illegible] boiled if made with great care. It can be made [illegible] vat without the addition of any other heat than [illegible] duced by putting the materials together in the proper [illegible] done by slaking the lime with hot water and [illegible] not third of the sulphur to the lime at the time [illegible] Keep the barrel covered with wet blankets [illegible] finished slaking add another third of sulphur [illegible] water [illegible] and the remainder [illegible]

add more boiling water and stir the mixture together; dissolve the caustic soda or lye in hot water and pour about one-third of this solution into the barrel and cover it quickly with blankets. A great deal of steam and gas will escape, but as much heat as possible should be held in. Let it stand ten minutes, stir it well and add the second third of the caustic soda or lye dissolved in hot water, cover it again immediately, and let it stand ten minutes more. Now stir it again, add the remainder of the caustic soda dissolved in hot water, cover it quickly and let it stand again ten minutes, when it is ready to add enough water to make the entire amount 50 gallons, and apply either as a spray or wash, just as in using any other of the lime sulphur mixtures.

We know where this has been made and used with emphatic success, and for comparatively few trees where one is not equipped to make the boiled lime-sulphur-salt wash, this can be made without the necessity of boiling, but at slightly increased expense. It is as satisfactory as any of the other washes of its general class, both as an insecticide and as a fungicide. It can be made with water heated in a wash boiler on a kitchen stove.

Caustic potash, or washing soda, or even concentrated lye, such as is sold in the stores for making soap, can be substituted successfully for the caustic soda, and it is probable that strong lye made from wood ashes can be used with equal success in place of soda. This formula is recommended particularly for a few trees or in a small orchard. It is no better than the lime-sulphur-salt wash, and is more expensive and troublesome. Unless made with great care, in order to procure and use all the heat possible, it will not be as effectual. This can not be made and used successfully by careless persons, as one can not get the proper combinations of the sulphur and lime without using boiling hot water and taking every precaution possible to retain all the heat that is produced.

(e) Livers of Sulphur, or Potassium Sulphide.

Potassium sulphide or livers of sulphur, 1 pound.

Fresh lime, 1 pound.

Warm water, 2 gallons.

Mix these together and apply as a spray or as a wash with a brush when the trees are dormant, or paint this mixture on the bark at any time. This is to be used in exactly the same manner as the other lime-sulphur washes, and is both an insecticide and a fungicide. It can be made in any kind of vessel and needs no other heat than that in the warm water. It is the most easily made insecticide that can be recommended for the San José Scale, and is therefore especially useful where one may have but a few choice trees which he may wish to preserve without the trouble of making any of the preceding mixtures. While it is the most easily made sub-

stitute for the boiled lime-sulphur-salt wash, it is at the same time the most expensive of this series of insecticides and, owing to the cost of the potassium sulphide, it cannot be used in large orchards or on many trees.

II. OILS FOR THE SAN JOSE SCALE.

There are several forms of oil that can be used with more or less success in killing San José Scale, but these must be used with care and with a full knowledge of the possible evil results of improper methods. One great value of the lime-sulphur-salt wash is that an inexperienced person cannot apply enough material prepared by any of the foregoing formulæ to injure the plant, while many trees have been killed by the application of too much oil or a mixture containing too high percentage of oil, or by oil of an improper grade. Trees vary in their liability to injury by such substances. While pear trees can often stand a spraying of thoroughly pure petroleum or even a light spraying of pure kerosene, oil should not be applied stronger than 50 per cent. to apple, or stronger than 40 per cent to plum, nor more than 25 per cent. to peach trees. In order to reduce the percentage it is necessary to apply the oil either in the form of a mixture, which is to be mixed by a mechanical device at the time of spraying, or in the form of an emulsion, in which the particles of oil are kept suspended in the mass of the diluting mixture, which is generally water.

No oil should be applied on trees until it runs down in streams and branches should never be soaked with it. It is particularly liable to injure the larger branches of trees by being absorbed by the thick bark, causing the death of this covering. We have seen many fine trees badly injured by the excess of oil that penetrated the thick bark of the branches. It is singular that this substance will not injure the thin barks of the trees as readily as the thick spongy bark, which seems to hold it longer.

(f) Crude Petroleum. Crude petroleum is a first class remedy for the San José Scale upon pear trees, but care should be taken to avoid soaking the thick bark with it. If this be used the operator should purchase only that which has a specific gravity of 43 degrees, Baume, or higher. Undilute crude petroleum cannot be safely used on apple and the other fruit trees, except pear. Several persons have killed plum trees with this material. (See Injured Branches, Plate ——.) A fruit grower in Jamesburg, N. J., recently told the writer that he had killed all his plum trees and 500 three-year-old pear trees by spraying them with crude petroleum. On the whole it is not as good an insecticide as the lime-sulphur-salt wash and does not have the added advantage of being also a fungicide.

In spraying with oils there is less danger of injury if the work be done on a bright, sunshinny, slightly windy day, so that the

evaporation will be as rapid as possible. The heavy crude petroleum, which contains paraffin, with but little vaseline or asphaltum base, is more likely to kill the scale without injury to the tree than the lighter varieties of this form of oil. The oils with vaseline or asphaltum base are especially injurious.

Oil Emulsions.

A good way to apply oil at a certain desired percentage of dilution is to make it into an emulsion. By this means one does not need an especially made spray pump, and with care he can obtain exactly the percentage of oil which he desires.

Make a stock of kerosene emulsion as follows:

(g) Kerosene-Soap Emulsion. Hard soap, or whale oil soap, one half pound; water, 1 gallon; kerosene, 2 gallons. Shave the soap fine in boiling water and thus dissolve it, remove this soap solution from the stove and add it to the kerosene while the water is boiling hot and churn it around through the spray pump a few minutes until it turns to a uniform creamy mass. If this be fully and properly agitated it can be kept for any length of time without the oil separating. For use add whatever amount is needed of this 66 per cent. mixture to enough warm water to give it the desired dilution. It should be remembered that the stock emulsion is only 66 per cent. kerosene, or two parts oil and one part water, and to use equal parts of this with water would not give a 50 per cent. solution, but one of only 33 per cent. oil.

(h) Kerosene-Milk Emulsion. In making small quantities of kerosene emulsion it can be made with sour milk and kerosene as follows: Sour milk, I gallon; kerosene, 2 gallons; churned through the spray and used in the same way as the soap emulsion. Where the lime-sulphur compounds cannot be made, this material will aid in holding the San José Scale in check, and upon apple trees especially some persons claim to have obtained better results than with any other material. Refined kerosene or common lamp oil is generally used in making emulsions, but crude petroleum can be used for this if desired. However, it often costs as much as does the kerosene and in a good emulsion of proper percentage it is no better.

(i) Oil Mixtures.

Either crude petroleum or refined kerosene can be applied in the form of a mixture by using a spray pump such as the Kero-Water-Sprayer, the instrument devised for making a mechanical mixture of the oil at the time it is applied. The great danger with such mixtures is the variation in percentage, and the consequent liability to injure trees by occasionally applying stronger than is intended. Thirty-five per cent. mixture of kerosene or crude petroleum will

kill San José Scale, and can be used upon all kinds of trees excepting peach, and the delicate varieties of plums. Upon peach and plum, especially, nothing is so effective or satisfactory as the lime-sulphur wash.

III. SOAP SOLUTIONS.

Soap solutions can be made to kill San José Scale if used strong enough, but it requires a greater proportion of soap than most people think necessary. To dissolve the soap use hot water.

(j) Whale Oil Soap.

Whale Oil Soap is a good insecticide when used in the proper strength and at the right time. During the summer while trees are in leaf it can be applied, dissolved in water, at a strength of one pound in five or six gallons, to destroy young scale insects and all kinds of plant lice. It is valuable for holding San José Scale in check during the summer, as it will do this without injuring the foliage, and is cheaper and more efficient than most of the commercial preparations that are given special "trade" names. During the time when the leaves are off the trees it should be applied at a much greater strength in order to kill off the older San José Scale. That which has been found most effective has been two pounds of Whale Oil Soap dissolved in one gallon of hot water and applied either as a wash or as a spray. This can be used with safety to the trees at a strength sufficient to kill the pest at any time when the leaves are off, although some persons claim that a fall application will injure the fruit buds and that the only proper time to apply a strong solution of Whale Oil Soap, in order to kill the scale and at the same time not injure the buds, is in the spring just before the leaves appear. We are conducting experiments with this at present and hope to report on them again next spring.

(k) Soft Soap, Laundry Soap, Etc.

Good old-fashioned country soft soap can be used to kill the Scale without injury to the trees by making it as thick as house paint and applying it with a brush or sprayer at any time when there are no green leaves to be injured by it. The chief point is to be careful to cover all the bark from the tip of the furthest twig to the base of the tree. Equal parts of soft soap and warm water will do the work. Common laundry soap, shaved fine and dropped into hot water, made into a strong solution, using at least three pounds of such soap to a gallon of water will kill the scale. Where there are only a few trees such remedies are to be recommended, but where many trees are to be treated this becomes too expensive. The strong soap solutions may be applied with brushes if care be taken to cover every part.

(d) With what to Spray. II. Apparatus.

In spraying, use a rubber hose from twelve to twenty feet in length to give plenty of room to swing from one part of the tree to another, and also an extension rod eight or ten feet long. This extension rod is generally bamboo lined with a brass tube. At the further end it should be curved or a curved piece called a "quarter turn" or an "eighth-turn" (which we like better) should be attached so that the liquid will not be thrown straight in the direction of the extension rod, but turned toward one side. By this device the upper portions or sides of the branches can be sprayed by reaching above them and turning the nozzle downward and by turning the extension rod over the two sides of a branch may be sprayed, even while standing in the same place. In all spraying operations from two to five nozzles should be arranged on the end of each hose or extension rod. The operator loses a great deal of time by attempting to spray with only one nozzle. The best arrangement for a barrel sprayer is a cluster of three nozzles set together and pointing in the same direction. This can be arranged by a triplet attachment to carry the nozzles and to screw into the end of the extension rod. Where the rod is not used the hose can be supported and elevated by a strong pole. Always run fresh water through the spray pump every day after using it to clean it, and keep it well oiled and in proper condition.

For this work any apparatus will serve the purpose that is able to throw the liquid in the form of a spray. The nozzle is one of the very important features of the apparatus and the one known as the "Vermorel" nozzle or its modification is best for general spraying apparatus. The kind of pump is not essential by any means but should be one that works easily, and throws a strong even spray with some reserve pressure when the handle is not in constant motion. For only a few plants the Knapsack Sprayer or a hand sprayer costing only three or four dollars will do the work, especially for small trees. For spraying a large tree properly it is as necessary to have a strong or powerful apparatus to reach its top as it would be to properly spray thousands of trees of the same kind. One of the advantages of cutting back trees is that material and labor are saved when it comes to spraying. A Knapsack sprayer is too slow for applying the material to several trees, and for this purpose a barrel sprayer is needed. It may be mounted either on side of the barrel or on the end as the operator may prefer. The barrel sprayer is undoubtedly the instrument that will be used by the general farmers and fruit producers of this State. For the more extensive growers with a great number of acres of fruit, and especially with large trees it may be best to have some

other than hand power, and such a machine is called a power apparatus. The power may be steam, gasoline, compressed air, or gas forced into tanks and charged as soda water tanks are charged. The merits of the different kinds of power are so important as to demand special investigation of the subject by each man who contemplates using a power apparatus, and would call for more space than can here be given it. Persons wishing to buy spraying apparatus should write at once to the various firms making such apparatus, obtain their catalogues, study them and order what they need. Among such reliable firms are the following: The Goulds Manufacturing Company, Seneca Falls, N. Y.; The Deming Manufacturing Company, Salem, O.; The Field Force Pump Company, Elmira, N. Y.; The Niagara Gas Sprayer Company, Lockport, N. Y.; The Friend Manufacturing Company, Gasport, N. Y.; Morrell and Morley, Benton Harbor, Mich.; The Dayton Supply Company, Dayton, O.; The Rippley Hardware Company, Grafton, Ill.; E. C. Born Company, Rochester, N. Y.; H. L. Hurst Manufacturing Company, Canton, O. There are other reliable firms of which persons can obtain addresses by consulting agricultural and horticultural publications, and most seedsmen are now also dealers in spraying apparatus and may be consulted upon this subject.

There are so many different kinds of Spraying Apparatus and so few persons are thoroughly acquainted with this subject that the selection of suitable apparatus is a serious problem. We have seen almost everything tried from a hand atomizer to a street sprinkling cart, and it is no wonder that we have received many letters of inquiry as to the best apparatus to use.

Success in using spraying apparatus depends upon throwing a definite spray or mist as fine as fog or mist on a foggy morning, and upon avoiding sprinkling or throwing the liquid in drops. The reasons for this are that the true spray or mist covers the leaves uniformly, having the desired effect upon every part alike, and leaving none untreated, while by sprinkling instead of spraying the liquid is applied in drops, and the leaves or plants are not uniformly covered, there are many places between the drops where the insecticide or fungicide has not reached, and, consequently, that are not protected, and the liquid composing the drops either runs together and off the leaves in streams and defeats the purpose of spraying by not staying on the plants, or it remains on the leaves and evaporates at the spot that was covered by the drop, leaving behind a mere concentrated solution which becomes so strong by the removal of water by evaporation as to burn holes through the delicate foliage at the places where the drops stood. The nozzle is the essential feature in applying the spray, and as all manufacturers of spraying apparatus now make the Vermorel nozzle it is enough

for us to say that for general purposes this is the best that can be used.

Each manufacturing firm is making several kinds of apparatus intended to meet the needs of more or less extensive growers. Any one of these fitted with a Vermorel nozzle will throw a spray and fulfill the purpose for which it is intended, but the question for the buyer is, what kind of apparatus will do the work that is needed in the most effective and economical manner? It can be seen at once that there is a reason why one kind of apparatus sells at a low price and another at a high price. The former is suited to only limited purposes and that on a small scale, while the latter is adapted for use on a larger scale. If a person have only a few plants around the house and garden, such as flowers in the flower bed, rose bushes, a few garden vegetables, a small patch of potatoes, a hen house, stable or live stock which he wishes to spray, or fences which he wishes to whitewash, the Bucket Spray Pump, shown in Figure 24, will serve his purpose. Such an apparatus he can buy from any reliable manufacturer for about six dollars. If he should wish to attach a hose and extension rod to this for spraying trees of small to medium size, he can do so successfully. This apparatus is to be used by standing it in a tub or bucket containing the liquid to be applied, and holding it firmly by resting the foot upon the outer support shown at the right side of the figure.

Fig. 24 Bucket Spray Pump.

If one have truck crops or a larger number of garden plants which he wishes to spray, and should prefer to carry the apparatus with him slung across his shoulder, the "Knapsack" Spray Pump is more readily portable, and, consequently, better suited to the purpose of carrying it about from place to place. It can, of course, be used for all the purposes of the Bucket Spray Pump, and may be either rested upon ground or carried by the operator while in use. Thus it has some advantages over the Bucket Spray Pump, especially for those plants like truck, which the operator wishes to spray as he moves along readily from place to place. Such apparatus costs from ten to fifteen dollars, owing to the size, complexity and attachments. (See Fig. 25.)

Fig. 25. "Knapsack" Sprayer.

If, however, one should wish to spray truck crops upon a more extensive scale, or many plants upon lawns, or fruit trees, either large or small, but especially large, he will need a Barrel Spray Pump, such as is shown in Figure 26. This pump may be mounted in the barrel either on the end or at the side, as the operator may desire, and it may have from one to four leads of hose, as may be necessary according to the extent of the operations undertaken. With all spraying it saves much time and is better to have a double nozzle on each hose, and in spraying fruit trees it is best to have at least a double lead of hose which means two hose pipes from the same pump, and have one man to handle the pump and drive the team and another man to operate each hose with its double or triple nozzle. In fact, the best spraying that we have ever seen done was with a hose on which there was a cluster of seven nozzles, and this threw a cloud of mist or spray that the operator could ride or walk along through the rows of his vineyard and do satisfactory spraying without ever stopping his team. In my own orchard I should use four nozzles on each hose, and feel that I was saving time and, consequently, making money thereby. From all reliable manufacturers and dealers the attachments for multiple nozzles may be purchased. While not more than two nozzles may be used with advantage upon the Bucket and "Knapsack" Sprayers, it will be a saving of time to use more than this upon the larger apparatus.

Fig. 26. Barrel Sprayer with Agitator.

With extra lengths of hose and an extension rod a person is able to apply the spray to the top of a tall fruit tree by the use of a good Barrel Spray Pump, and if he should have a few extra nozzles, such as the "Bordeaux," that can be made to throw a stream when desired, he can readily force the stream of liquid over the top of an ordinary farm building. All good spraying apparatus that works in a closed vessel has an attachment toward the bottom of the vessel called an agitator, as shown toward the bottom of the barrel in Figure 26. The purpose of this is to keep the liquid stirred, so that when using such substances as Paris green it will not settle to the bottom, and be unequally applied to the plants at different times.

The Barrel Sprayer may be mounted upon wheels and used as a cart, if desired, but the barrel carts are useful only upon sod or firm ground and can not be pushed by hand on soft ground. Such an apparatus is, of course, fitted for more extensive operations, and is such as is best suited to the needs of the average fruit grower. The cost of a Barrel Spray Pump, with hose and nozzle, varies from

fourteen dollars to fifty dollars, according to size, complexity and attachments. In all of these pumps previously discussed in this article one can use any of the arsenites, kerosene emulsion, whale oil soap, Bordeaux mixture and other fungicides, and the lime-sulphur-salt wash, but with these ordinary spray pumps you can not apply the kerosene mixture.

For the application of the kerosene mixture, which is simply kerosene or common lamp oil mixed with water to a desired percentage at the time it is applied, the operator must use a pump with an oil attachment as shown in Figure 27. The manufacturers are producing Bucket Pumps with this attachment for about ten dollars, and "Knapsack" Pumps with the same for about twenty dollars. While the Barrel Pump with the kerosene attachment costs from fifteen to twenty-five dollars, owing to the fittings or supplies that may be ordered therewith. This tank is detachable, and when removed the pump can be used for all purposes for which the previously described apparatus is adapted. In using the kerosene mixer the oil is put into the inner tank and the water is placed in the vessel in which this tank rests. The two are mixed at or near the desired percentage at the instant of application. This gives a valuable means of combatting suctorial insects such as plant lice and scale insects, which can not be killed by the arsenites, and relieves the necessity of making the kerosene emulsion, but the objection to this apparatus and the kerosene mixture is that the percentage of the oil is likely to vary to a greater or less extent from that which is desired, and may thus not have the desired effect at certain times. The mixture is made at the top of the barrel or tank, where the pipes from the water and the oil come together, and before this mixture enters the hose pipe. It can thus be seen that when the operator stops work to move from one place to another there is a settling of the water in the lower part of the hose between the tank and the nozzle, while the oil rises to the upper part of the same hose. When the spraying is again commenced, there will be a few seconds during which almost pure kerosene will be applied to the foliage with burning effects, followed by a brief application of almost pure water before the mixture of the desired percentage is applied. While we prefer and recommend kerosene emulsion for this particular purpose, applied with the ordinary Barrel Sprayer, the oil tank apparatus has its place and will prove of especial value in destroying young scale insects and plant lice, if one does not use kerosene emulsion or whale oil soap.

Fig. 27. Barrel Sprayer with Kerosene Attachment.

An attachment that is worthy of note is the field crop sprayer shown in Figure 28. This is to be attached to the hose from a regular barrel sprayer and is used for spraying low field crops, such as beans, peas, celery, tomatoes, cabbage, potatoes, beets, etc. For spraying peas for plant lice and a few other special crops and insects up-turned nozzles are needed to throw the spray against the under side of the leaves, but for the average field crops in applying either insecticides or fungicides, this will be found very useful and is especially useful in spraying potatoes for potato blight and rot. The one mistake that is made in this illustration is showing the barrel mounted in a four-wheeled wagon. Every practical grower of potatoes knows the difficulty in turning around in his field with such a vehicle. The apparatus may be used as effectively when mounted upon a two-wheeled cart with much less damage to the crop from horses and wagon.

Fig. 28. Field Crop Spraying Attachment.

The power to be applied in using spraying apparatus depends upon conditions. If one having many trees, especially if they be of large size, it is desirable to use compressed air, or a gasoline engine, or steam power for driving the apparatus. With almost all good barrel spray pumps attachments are provided for connecting with such power. A discussion of what kind of power is best on premises that demand more extensive operation than can possibly be performed by hand would be too extensive for this Bulletin at present. Some persons prefer one kind of power and some another. Those who wish to see the different kinds of power in operation will find it to their advantage to visit different persons in our State who are using each kind respectively, and the names and addresses of such operators will be given upon application to this office. One kind of power that is very satisfactory under certain conditions is that to be derived by the attachment directly to the wheels of the vehicle which carries the spraying apparatus. This will prove satisfactory where one is spraying grapes or field crops for which he can drive more or less continuously while spraying, and is really satisfactory only when a compressed air attachment is used to equalize the pressure generated by the wheel power.

[We are indebted to the manufacturers of apparatus for the loan of cuts, as follows: Nos. 24 and 27, the Goulds Manufacturing Company, Seneca Falls, N. Y. Nos. 25, 26 and 28, Deming Manufacturing Company, Salem, O.] H. A. S.

II. INEFFECTIVE OR UNSATISFACTORY MEANS.

(a) Singeing or Burning.—It has been suggested that scale insects can be burned from trees by using a kerosene blast lamp or by coating the trees with a film of kerosene sprayed on it and setting fire to this. Extensive experiments with the blast lamp for scale insects have been performed by Prof. Forbes, of Illinois, and the Illinois Experiment Station has published a bulletin upon that subject. The conclusions are that the results of the burning are unsatisfactory for different reasons, and Prof. Forbes, who is one of the greatest authorities in the world in economic entomology, has recently written us that he considers the lime-sulphur wash the best tried remedy that he can recommend for San José Scale.

A few persons have found it possible to coat a tree with a spray of kerosene and on a very calm day set fire to it and burn off the scales. We have reports of success by this method, but doubt its advisability as a general remedy, and can only say that we intend to try it and report results.

(b) Scraping and Brushing.—During the past year many unscrupulous persons have appeared in different parts of the State and have defrauded ignorant tree owners, especially in villages and on wealthy estates, by scraping their trees under the pretense of removing the San José Scale for a very high compensation. The loose bark has been scraped from the trunks and larger branches, but of course few pests have been removed by such methods, and practically no desirable effects have come from it.

If one have only a few small trees partly infested with scale insects, it is possible to get rid of most of these pests by scraping the trunks, branches and trees with a blade or coarse sand paper, but every particle of the bark must be treated by this means. The San José Scale is so small that it cannot be seen and removed with certainty with this method, although it may be possible to get rid of the oyster-shell by scraping. However it should be emphasized that every infested part of the tree should receive proper attention, even to the tips of the twigs, and the trunk is, in many cases, the least important part to scrape.

Between scraping and washing, we certainly approve washing with brushes, using one of the lime-sulphur washes not much stronger in proportion nor thicker mixture than is generally recommended for spraying.

(c) Spraying with Substances not Properly Prepared nor Applied, or with Something that will Injure the Trees.—We have received reports of the Lime-sulphur Wash not giving good results. Upon careful investigation of the causes of failure we have found that invariably they are due either to lack of boiling the mixture or

spraying it on the trees in a very imperfect manner, only partially covering the branches. It does not matter how perfect the apparatus in every regard, nor how good the material, if it be not heated enough to make the chemical union of the Lime and Sulphur, the desired results will not be obtained, and persons having failure from such causes are not justified in condemning spraying. The same is to be said of lack of perfection in covering the trees. They should be entirely coated with a double coat or second spraying and not a dark or uncovered spot should be left anywhere upon the trunk, branches or twigs. Most failures with this substance are due to such carelessness. It is not the fault of the material nor of our recommendation.

Of course, unsatisfactory results come from using materials that injure the trees. We have just received a report from a farmer two miles east of Steelton, Pa., who killed his peach and cherry trees by spraying them with Crude Oil. Readers know that we have advised against the use of this material, except when dilute, for the very reason that it will prove distructive to most kinds of trees when applied pure. This farmer is not justified in condemning spraying, although with him the results were unsatisfactory. He could have obtained reliable information, without charge, from this office, and since our inspector has carried to him the knowledge of proper methods he says he will spray with the right material and save his trees in the future.

(d) Cutting Down the Worst Infested Trees.—We are frequently asked if it will not suffice to cut down and burn the worst infested trees and let the rest remain untreated. We wish to state emphatically that this will give no good results. It is not necessary to cut down a tree when infested with the San José Scale, and if the scale has been on it very long other trees of certain varieties in the vicinity are almost certain to be infested, whether it has yet become conspicuous on them or not. For this reason the scale will surely be left in the orchard and will spread just as rapidly as though the originally infested tree had not been destroyed.

With this in mind, it is seen that spraying some of the worst infested trees, but leaving others untreated, is also an ineffective or unsatisfactory means of really suppressing the scale; while the sprayed trees would be benefited by such treatment, those not sprayed will continue to maintain the scale until they are treated or until its effects are conspicuous upon them. If there be any trees or shrubs infested with San José Scale on the premises, all those of varieties liable to be attacked by this pest and within a few rods of the infestation should be sprayed as thoroughly as those upon which it is to be plainly seen.

(e) Using Unreliable Commercial Materials.—There are a few com-

mercial insecticides that are fairly good under certain circumstances, although quite too expensive for general use, but there are a great many others that are entirely unreliable. Although highly recommended by a few persons, especially those who are interested in their sales, they should not be used extensively on important trees without tests have previously been made or information obtained from a reliable source concerning them. This office is always ready to give full and free information on such subjects and refer inquirers to other persons in various parts of the country who will give independent reports, and which may be compared with ours. It is not justice to the general cause of spraying for any one to use some unreliable material, and then say that spraying does not give good results.

There is a great need of an ideal or perfect insecticide prepared ready for use, but such has never yet been perfected and much of the commercial material on the market is worse than useless. Do not condemn proper methods because some material fails.

(f) Using Unreliable Home-made Preparations.—The use of home-made preparations which are unreliable for the San José Scale is as bad in unsatisfactory results as any of the processes named above. Some person thinks he will devise a means of fighting the scale, and he consequently mixes up some original preparation, like a solution of wood ashes in water, and plants it on the trees. If these be much infested they will be dead with the scale before he can have time to see the results of the application upon the condition of the tree itself. Among the home-made preparations that are not reliable are dilute soap solutions and low percentages of oil mixtures or emulsions, solutions of lye, caustic soda, washing soda and numerous other materials. In many cases the substance used would itself kill the scale if applied stronger, but at the same time there is great danger of serious injury or death to the trees by the use of strong insecticides in the hands of beginners who are using them experimentally. Thus, the two great risks in the use of new materials are (1) In not having them strong enough to kill the pests, and (2) making them so strong as to injure the trees. To avoid such troubles, correspond with this office or with other persons who have experimented with them. Experimenting to a limited extent may be desirable and valuable, and is recommended, but it certainly is not desirable for any one to depend upon untried materials for saving many trees nor for general use.

(g) Treating only a Portion of Infested Trees or Shrubs.—Nothing but unsatisfactory results can come from treating the trunks and larger branches of trees with any insecticide, however good it may be, and leaving the smaller branches and twigs covered with the pests, which continue to feed and inflict their deadly injuries.

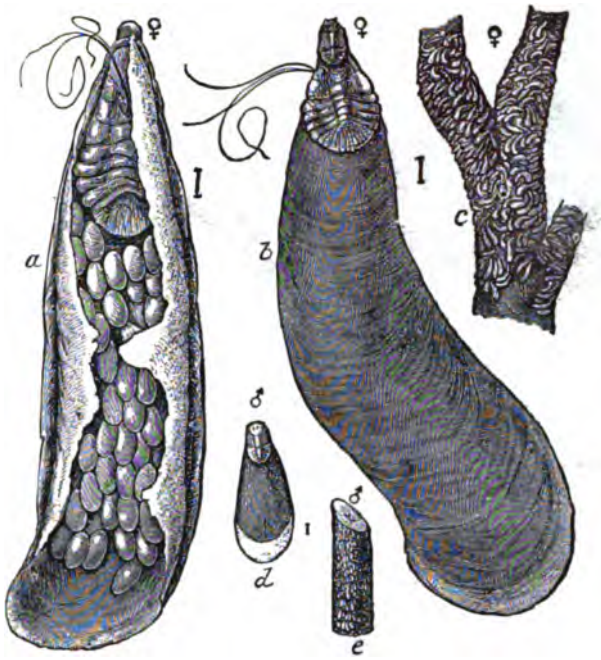


Fig. 1.—Oyster-shell Scale (*Mytilaspis pomorum*). a, under side of female scale, showing eggs as seen during Winter and Spring; b, upper side of same; c, female scales, natural size, as seen on badly infested branch; d, male scales; e, branch covered with male scales. c and e are natural size, and a, b, and d are greatly enlarged. The straight lines at right of a and b indicate their natural size. (From *Howard, in Yearbook of U. S. Dept of Agr.*)

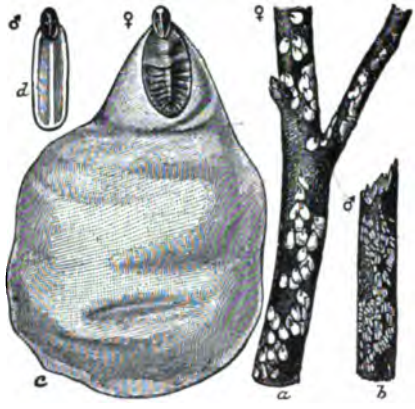


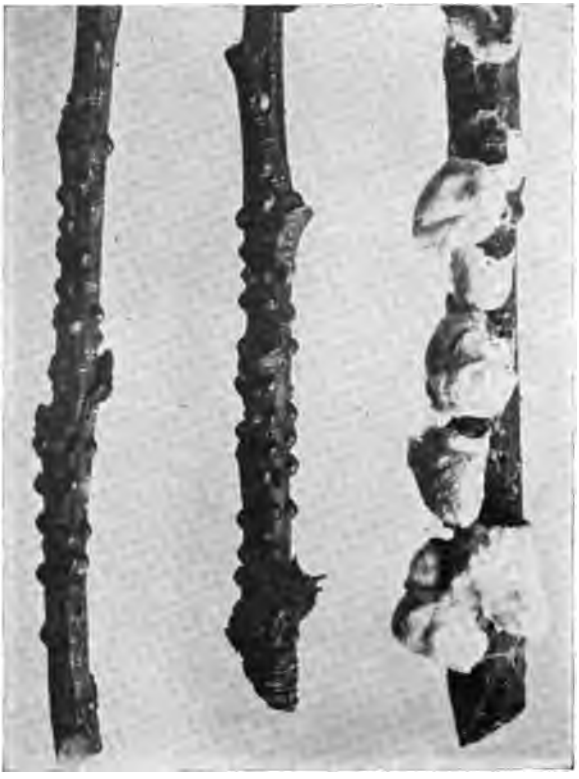
Fig. 2.—Scurfy Scale (*Chionaspis furfurus*); a, female, and b, male on twigs, natural size; c, female scale, upper view, much enlarged; d, male enlarged. (From *Howard, in Yearbook of U. S. Dept. of Agr.*)

PLATE XLIX.

a b c

PLATE L. SCALE INSECTS.

a. Scurfy Scale. Small Specks, Males; Large ones, Females.
b. Scurfy Scale. All Females, Adult.
c. Oyster Shell Scales.
All photographed in the Office of the Economic Zoologist.
All Natural Size.



a b c

PLATE LI. COMMON SCALE INSECTS.

a. Cottony Maple Scale.
b. Lecanium or Turtle-Shell (Soft Scale) on Plum.
c. Lecanium or Turtle-Shell Scale on Maple.

All Natural Size. Photographed in the office of the Economic Zoologist.

Spraying with Gasolene Power, showing Tank with Platform above for reaching high trees. From Photograph taken on the premises of Mr. Jas. Boyd, near Harrisburg, Pa., by the State Zoologist.

PLATE LII.

A prominent merchant of Philadelphia paid one hundred and seventeen dollars ($117) to have his trees treated for scale insects, and after having made sure that the trunks were painted all around he was satisfied with the false hope that his trees would be saved from further injury, but was disappointed later.

Any means of applying remedies for such insects as the San José Scale must reach all of the bark of the branches and twigs, or it will be entirely unsatisfactory in results. This is why spraying and fumigating are practically the only methods of obtaining success in treating the San José Scale.

12. Commercial Insecticides.

We are frequently asked concerning preparations that are on the market under various commercial names for the purpose of destroying insects, or at least for extracting good money from the pockets of the agricultural people. We take this opportunity to reply to the inquiries by saying that there is no known commercial preparation which meets the requirements of an ideal insecticide for the San José Scale as nearly as does the home-made boiled Lime-Sulfur wash, thoroughly applied to the infested trees in such a way as to cover them entirely, as though they had been white washed. However, one objection to this preparation may be that it makes the trees have a whitish appearance, and on a lawn this may be considered objectionable by some persons, although there is no reason why there should be any serious objection to the whitened branches. The only other advantage of the commercial insecticides over the Lime-Sulfur wash is the ease of preparation and application of the same. All that is necessary with most of them is to dilute with a certain amount of water and apply as a spray or wash. The three great disadvantages are:

1. The considerable expense involved in using such materials, as they are many times more expensive than the Lime-Sulfur wash.

2. The fact that the commercial insecticides will not kill the Scale at the strength recommended by the manufacturers and agents, and consequently must be applied so much stronger than is claimed in the advertisement that the cost becomes much greater than was anticipated. If a person have only one or two trees that he desires to treat he can do this in an effective manner by using the commercial insecticides, but they must be applied in a much more condensed form, or less dilute, than is given in the advertisement for the regular formula. Otherwise they are not liable to give good results in killing the scale or even holding it in check.

3. Commercial insecticides as a rule have no fungicidal value and consequently we can not say of them, as we do of the Lime-Sulfur

suade him to endorse their worthless material, but he stood firmly to his principle, with the results which we now see. Within the last year the manager of the firm was in this office and acknowledged that we were right, and they were not justified in claiming such great merits for their production. He also said they had entirely abandoned it, and were making another insecticide that was of quite a different nature. They are now putting on the market a different preparation with the knowledge that the farmers and fruit growers are in great distress concerning the ravages of the San José Scale and are willing to pay quite a price for material that is recommended to be effective and easy to apply. However, their new material has not been fully proven, and we therefore caution fruit growers and farmers to use great care in connection with commercial insecticides. They should first buy and apply it then only as experiments on a few trees. If at the end of a full year from the time the application was made the trees are showing decidedly beneficial results from the effect of the application there is no reason it should not be used more extensively, but it is advisable for persons owning infested trees and shrubs to pin their faith to the known and tested insecticides which are tested and recommended in this Bulletin.

In this connection, one of the most stupendous frauds which has been perpetrated on the people of Pennsylvania is in the production of a preparation at Waynesboro, Franklin county, Pa., which was formerly called "Kill-Scale" and is now being put on the market under the name of "Ska-kil." This firm would not send us any for test or examination when we requested it, and even when we offered to buy it of them they would not supply it, but we obtained some of it through a third party and had it analyzed at the State Experiment Station. The results of this analysis was that this production is nothing more than powdered sulfur, with a little resin and a little gun powder added. It costs the manufacturers less than five cents per pound and they sell it in considerable quantities at $1.00 per pound. We have tested it with great care and have examined orchards in which it was used extensively and are prepared to say that it is absolutely worthless, and worse than worthless. It is to be applied by boring a hole in the trunk of the tree and inserting the powder in the hole and then pounding in a plug. The sample which we applied in this way last February and March in our experimental work still remains entirely undissolved in the hole in which it was placed, and no beneficial results are noticed on the trees, while they are dying by the increasing generations of scale insects which continued to multiply upon them during the summer. Orchards in which it was used by other persons are dying from the effects of the living scale, in addition to the injury inflicted to the

trees by boring the holes in them. We have no hesitation in expressing in a most emphatic way the unqualified condemnation of this material as a remedy for scale insects or any other pest or disease of trees, when applied in such a manner.

However, we have been recently told that a hardware dealer in Chambersburg sold 40 pounds of it in one day and hundreds of pounds have been purchased by fruit growers in Franklin and Adams counties, and in fact it has been shipped to many states of the Union.

In making this declaration for the sake of the protection of the residents of this State, whom it is our duty to serve, we recognize the importance of justice to all men and can not be charged with animosity against the firm producing "Ska-kil," as we do not know these gentlemen personally, although we are told they are responsible and well-meaning citizens but persons who have had no experience in fruit growing and have really deceived themselves into believing that the production is beneficial and effective. We also have due regard to our own reputation as a scientist and citizen and the well-fare of the citizens of this State. In making the above remarks concerning frauds the Economic Zoologist places himself responsible for any suit or damage that may be contemplated, and is prepared to offer positive proof of his statements in any court in the country. The lesson to be drawn from the above remarks is that persons having trees and shrubs that are infested can not be too careful in using the untested or even recommended commercial insecticides.

Another fraudulent practice that can not be too strongly condemned is that of painting the trunks and larger branches of trees with materials of any kind, and considering them treated properly for the San José Scale. In the vicinity of Philadelphia red ochre has been used for this purpose, but of course it was used only to obtain money from the owners and not for beneficial results to the trees.

Among the fake schemes are such as washing the trunks of the trees with some kind of material, scraping the tree trunks, burying material in the soil around the roots, and boring holes into the trees and injecting various preparations ranging from sulphur to asafœtida. We need not take more space than to renounce every such scheme as entirely impractical and unworthy of serious consideration. The great trouble is that the originators, agents or "sharpers" who are trying to use such tricks for their own financial benefit are sure to prey upon persons who are ignorant of the care of trees, and they always say that "Scientific men are against them," because they "have made a great and wonderful discovery" which is to revolutionize our views of science and they try to make the public be-

lieve that scientists are so narrow as to oppose them merely because they have something "new."

Several kinds of material have had more or less wide circulation and advertisement as supposed remedies for the San José Scale, but upon the one test to which all should be submitted before receiving commendation,—practical application in infested orchards,—it has later been found that many have proven useless and persons who rely upon them will lose their trees before they become aware that they have been misinformed.

A striking illustration of this was the advocacy of caustic potash dissolved in water. A champion Annanias won a prize of twenty-five dollars from a standard agricultural paper for fixing up a nice story about the ease and surety of this wash, and it was published in one of the most reputable agricultural papers of our country. From that source it has spread, and although we condemned it from the beginning, we are yet receiving many inquiries as to its efficiency. It should be enough to say that it will not kill the scale unless used strong enough to kill the buds also. Thus it is to be avoided.

Another comparatively useless material that has had very wide advertisement without having been first properly tested and which did not stand the one important test of practical application is the lime dust known by the trade name of "Limoid." Neither in any of our experiments nor in any orchard where it has been used, that we can find, has kerosene and lime of any kind or brand given satisfactory results, and thus this material has already fallen into disfavor. We at first thought it promised good results, but later experiments and examination of orchards where it was used, show the justice of this later conclusions. If repeated trials should give in the future any better results than we have recently obtained they will be published in these Bulletins.

For all new materials, of any kind whatever, the rule of the practical orchardist should be to try but a little of each kind at first, or learn who had given them an honest and thorough trial before buying and using much. It is a serious thing for a man to lose his orchard through treatment with improper materials, either killing his trees or leaving enough living scale to do so. Growers should always watch that persons claiming to have made certain tests are not either the originators, and thus unduly biased in favor of their own, or agents and consequently interested in the profits of sales of the same.

In the Eastern part of this State and in New Jersey there have been some widely-circulated newspaper accounts commending crude carbolic acid as a paint to use on the larger branches and trunks of the trees to kill and prevent the San José Scale. This is not bene-

ficial in actual practice, notwithstanding the extensive advertisement that has been given to this process.

14. Causes of Failure.

Persons occasionally write to us that they have met with failure or had unsatisfactory results in the use of the Lime-sulfur Wash, or other insecticides. In analyzing the causes of such reports we have come to the conclusion that they are due to one or more of the following:

1. Attempting to make the mixture without boiling it. It is entirely impossible to bring about the proper chemical union of the Lime and Sulfur without heat, and a sufficient amount of heat to make a proper union can not be produced by chemical means alone. It is necessary to use artificial heat or fire, and the material should be boiled at least an hour. This means an hour from the time it commences to boil, and not from the time that it is placed over the fire. It also means real boiling and not mere simmering.

2. Lack of straining. Lack of satisfactory results may at times be due to lack of care in straining and also to clogged nozzles with disastrous results, such as bursting hose, ruining clothing, bleeding hands, face and neck or removing hair from horses, and other difficulties which quite disgust the operator and tend to make him pronounce the process of spraying a failure. The failure is often due to such minor features of the operation, as lack of proper straining in order to prevent the clogging of the nozzles.

3. Not entirely covering the trees or shrubs. It is necessary that the outermost tips of the twigs and tops of the highest branches should be reached and covered entirely by the Lime-sulfur Wash if this is to give satisfactory results. Merely spraying the trunks, larger branches and tops of the trees will not give very pronounced effects. If it be impossible to reach the very tips of the highest branches, it is much better to cut them off than to let them remain untreated. Use a long hose, a tower built upon a wagon, a good long and strong extension rod, and on tall trees use tall ladders and try to get the nozzle above each branch that is to be sprayed.

4. Failure to give a second coating. During the first spraying of the trees all spots should be covered. As soon as the material is dry enough to permit the operator to see any that is not coated he should give the second or retouching spraying. This may be within an hour or within several days of the time of applying the first coating. The material should be put on as abundantly as at the first spraying. In fact, the best results that we have seen from the use of the Lime-sulfur Wash came from the application of three or four coats, one after the other, as soon as the one pre-

viously applied became dry. Mr. Clayton Miller, of Marion, Franklin county, Pa., recently reported to the writer that he had very excellent results in cleaning up the San José Scale on his fullgrown apple trees by this means. He applied the boiled Lime-sulfur Wash until every portion of each tree looked as though covered with a thick coating of whitewash.

5. Rainfall before the material is dry. If rain follow the operation before the material sprayed over the trees becomes dry enough it will be washed away, and its killing effects will be greatly reduced. In such an event as this the trees should be again sprayed just as though they had not been treated before the rain.

6. Trying to spray against the wind. No person can throw a spray against the wind for the reason that a spray goes out of the nozzle as fine mist or steam, and it is very easily carried by the wind and can not be forced against the wind for any great distance. It is an easy matter to spray with the wind, and it is best to do this at all times. Good results can be obtained from spraying the entire orchard from one side or the side that is toward the wind, and when the wind changes, even though it may not be for weeks, spray the other side of all the trees, giving them their first and second coats just as though the entire trees were being sprayed.

7. Not using enough power or pressure in spraying. A spraying apparatus that will barely throw a spray as a light mist over the branches of the trees will not result in nearly the killing effects that will be produced by one that will drive a misty liquid with great force against the bark into the little crevices and under the scales, bark and lichens where the very minute specimens of San José Scale find their winter protection. Spraying with considerable pressure or power certainly gives better results than spraying with only enough pressure barely to reach the parts of the trees to which the liquid is to be applied.

8. Spraying in the fall only. Fall spraying is all right if it is to be followed by a spring application, but we have proven to our satisfaction that fall or winter spraying only will not bring the desired answer. The one time of spraying above all others that will give the best results is in the spring just before the buds burst and as near as possible to the bursting of the buds. However, if trees be badly infested we earnestly recommend two applications of the insecticide, one being in the fall shortly after the leaves drop and the other in the spring just before they appear. From our experiments, given on a previous page of this Volume, we are of the decided opinion that there is much depending upon the proper time of making the application, especially if the material used be the Lime-Sulfur Wash.

9. Using as Lime, Magnesium Oxide instead of Calcium Oxide. It

appears that many operators have had good results from the use of the Magnesium Lime or Oxide of Magnesium, but some cases of failure have been traced to the use of this milder material. Of course, Limestone, so-called, contains varying percentages of Carbonate of Lime and Magnesia, ranging from practically none of one through nearly equal parts of each to almost none of the other. The Calcium or pure Lime is the material which gives the strongest wash when boiled with the Sulfur and consequently gives the best results. Unfortunately, we can not give any easy method by which the operator can determine which form of Lime he is using, and as we do not make chemical analysis of any substance at this office, it is useless for our friends to send this material to us to be analyzed.

10. Sprinkling instead of Spraying. Failure comes from either using a poor nozzle or poor pressure. When the liquid goes in drops or a sprinkle instead of a spray, the infested bark is not uniformly covered and unsatisfactory results are obtained.

11. Failure to trim or prune before spraying. All injured trees should be pruned back in proportion to their injure. This is necessary to restore their vigor as well as to permit thorough spraying. This should, of course, be done before the operation.

12. Using Old or Air-slaked Lime. Unsatisfactory results may come from using air-slaked Lime. Follow carefully the directions given in this Bulletin, and if questions arise, write to the State Zoologist.

15. What to do with a Neighbor's Infested Premises.

We have received a few letters to the effect that the premises of a neighbor are badly infested with the San José Scale and that something should be done concerning them. Where definite complaint is made we follow the requirements of the law in this regard. The law provides that where the attention of the Department of Agriculture is called to the fact that there are such injurious insects as the San José Scale supposed to be upon any property it is the duty of the Secretary of Agriculture, acting through the Economic Zoologist, or other agent, to inspect the premises supposed to be infested, and if the San José Scale or certain other destructive insects, or plant diseases be found there, the owner is notified in writing to treat the trees containing such pests, by the method which we consider best according to the particular conditions. He is given a certain length of time in which to do this work. At the expiration of that time a second inspection is made, and if at that inspection he is found not to have complied with the pre-

presence of the liquid from the crushed scale is a very strong evidence that it is yet alive. This test can be applied and the results determined by the unaided eye at any time of the year.

18. Commercial Spraying as a Business.

We have recommended as one way out of the trouble now facing farmers and fruit growers that some person in each township or community purchase and operate a first class sprayer to treat their trees at a reasonable price and make good profits for himself and his neighbors. We are satisfied that we could, with great profit, take an average orchard on a contract to spray it all that is necessary to produce first class fruits, and receive as compensation only one-half the extra income from the orchard in excess of that which would have been obtained had it not been sprayed, and at the same time make a good profit on the contract. Almost every orchard can be made to yield much more than it does in the way of profits, because by proper attention not only can the crop be increased, but the quality can be improved wonderfully. The objection to a spraying apparatus operated by some individual is that the owner in some cases may not know if the work be properly done, especially if substances be used which leave no marks or stains upon the trees. However, with the Lime-sulfur Wash this objection does not hold, because the one rule is to apply it so thoroughly as to make the entire tree look as though it were covered with a coating of whitewash, reaching the tips of the most remote branches. The owner can readily see if this has been done within a few hours after the application is made, even if he may have no knowledge of the method of spraying.

Commercial spraying outfits are operated upon a basis of compensation agreed upon according to the size of the tree or trees to be treated, and the number of the same. The price ranges from ten cents to one dollar per tree, and this is by no means too much for properly sprayed apple trees of full size, giving the second coat or retouching spraying. A person can afford to spray very small trees for only five cents per tree and make considerable money by it. The cost of the material is only about one cent per gallon, and it requires only two gallons to spray thoroughly a tree the size of a full grown peach tree of average size.

In some places, especially in New Jersey, the commercial sprayers charge for the material by the gallon, and this is applied without other compensation. Under this plan they are charging ten cents per gallon for spraying trees with the Lime-sulphur Wash. The justice of this would depend upon the number of trees to be treated [illegible] time that would be lost in moving from place to place, but

on an average a person could afford to spray trees the size of an average peach tree of full growth for five cents per gallon for the material applied to the trees, and make a good profit in so doing.

It has been found unsatisfactory to attempt to operate a spraying outfit at a straight bargain of fixed wages per day for man, time and apparatus. One person, who was a competent man, tried this in the vicinity of Lock Haven, asking only five dollars per day for the services of himself, assistants, team and apparatus, and he to furnish all the material. His method met with failure because it was thought he was asking too much for what he proposed to do. At the same time, another man in the central part of Pennsylvania took a contract to spray eight hundred trees at fifteen cents per tree, and with two assistants and a power sprayer finished the job in only one day. It can be seen that the cost of spraying this orchard was one hundred and twenty dollars. However, the owner appeared to be satisfied, as he knows his trees were saved by the treatment.

In doing commercial spraying it is advisable to have an apparatus that is operated by power of some other kind than the human hand. While a barrel sprayer (pump) is a fairly good means of reaching the average farm orchard, and can be made to give excellent results, it is not as satisfactory as spraying by means of gas, compressed air, gasolene, steam or some other power. The power sprayer gives both stronger pressure and more constant or steady pressure than could be obtained by a hand pump, and both of these are important features in killing the scale and saving materials.

19. Testimonials of Successful Spraying in Pennsylvania.

(Held for the next issue of the MONTHLY BULLETIN.)

20. Other Kinds of Scale Insects.

There are a great many other kinds of scale insects than the San José Scale, three of which are commonly seen by fruit growers. Among these is the Oyster-shell Scale (Plate XLIX, Fig. 1), sometimes called the Apple-tree Scale, because found most commonly upon this tree. This infests apple, ash, box elder, lilac, linden, willows, and a few other kinds of trees and shrubs, but does not have such a wide range of food plants as the San José Scale, and does not injure the host or food plant as seriously. The life history of this pest is discussed in our July Bulletin, and the remedies are there given.

Another common scale insect is the Scurfy Scale (Plate XLIX, Fig. 2) of which there are really several species, but so much alike that none but an expert would recognize the differences. This pest commonly infests apple, pear, mountain ash, and in fact many other

varieties of trees and shrubs, but is rarely seen so abundant as to destroy them, although its effects may be quite serious. It also lays eggs, and has a life history similar to that of the Oyster-shell Scale. This is also illustrated and discussed in our July Bulletin to which persons are referred.

We have positive evidence of the beneficial results of the Lime-sulphur Wash in destroying both the Scurfy Scale and the Oyster-shell Scale. This is the first time we have said that this preparation positively can be recommended to kill the Oyster-shell Scale, but this is said after careful tests and due reflection upon the subject.

The third scale which is commonly observed by fruit growers is called the Turtle-shell Scale or Soft Scale (Plate LI, Figs. b and c). It is found mostly upon peach and plum trees, and for that reason is commonly called the peach scale. This has a peculiar life history in the fact that the old scale dies in the latter part of fall after the young have appeared and fixed themselves upon the branches of the peach and plum trees. The young pests remain in this exposed condition during the winter and develop next spring and summer. They are easily killed by the regular application of the Lime-sulfur Wash, using it the same as for the San José Scale.

Upon the rose, and sometimes upon the raspberry, there is another species of scale commonly known as the Rose Scale. This is also to be treated by the same formula as are the others. Thoroughness of application is an essential feature. The various species of scale insects are to be discussed in one Bulletin upon this subject, which will be issued in January or February.

21. The Outlook.

What remains to be said concerning the outlook of fruit growing in Pennsylvania? It is indeed not as bright as we should desire, and one reason is that the farmers and fruit growers are not aware of the importance of modern methods, and many persons do not understand the possibility of saving their crops by careful spraying. In our Bulletin over three years ago we published that the outcome of the San José Scale in this State could result in but one of four ways:

First. "Have men trained in the science and art of spraying and equipped with proper apparatus to go from orchard to orchard and treat the trees with such fungicides and insecticides as they need, receiving proper compensation for their services; just as owners of threshing machines go from farm to farm to do threshing and are paid by the individual owners of grain, according to the amount of work done for each.

Second. The second course for the relief of the husbandman lies

in the specialization of soil productions. The farmers to produce the field crops and the horticulturists to grow the fruits, the one purchasing the products of the skill and labor of the other."

Third. "The third course that may be possible for the future is for all tillers of the soil to become so educated in the science and art of agriculture that they may be able to adopt the methods and use the apparatus that will insure the destruction or suppression of the pests of their crops and consequently yield satisfactory results in produce."

Fourth. "The last and least desirable way out of the dilemma is to abandon all efforts at fruit culture in this State, let the San José Scale run its course, which thus must be inevitable and most disastrous, unless promptly met with new and heroic methods."

These predictions were expressed in our Monthly Bulletin for October, 1903, Vol. I, No. 6. It is now being seen how accurately the foretold conditions are approaching.

The public sprayer with his apparatus has sprung up in many parts of this State and is doing fine work for his fellowmen and earning good financial return for himself. Should we name the almost fabulous sums that we know were earned in a short time last spring by a person operating a good power sprayer we would scarcely be believed. We know of more than a score of persons in this portion of the state who have taken up public spraying, and indeed one could quite profitably be sustained in each township of the fruit growing districts of the Commonwealth. There is much more money to be made by owning and operating a spraying apparatus than by a threshing machine.

The specialization of fruits produced by horticulturists and the production of farm crops by the farmers is becoming more prominent every day. Many farmers say they will let the scale take the trees and then buy what fruit they may need before they will be bothered with a spraying apparatus, and on the other hand the fruit growers are producing better crops than ever before, and selling them at a much higher price than formerly. There will be in the future a greater tendency toward specializing than in the past. It is true that the person engaged mostly in the production of farm crops is becoming more discouraged on account of the Scale, while the producers of fruits are becoming more encouraged and in many places are planting young fruit trees with great energy. However, many thousands more will have to be planted within the next few years to meet the great loss that our State has recently sustained and may meet during the next few years to come.

There is no doubt about the increasing general education of the tillers of the soil. The fact that many farmers are preparing to avail themselves of such information as pertains to the fighting of

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OUR MONTHLY CHAT WITH READERS.

We are sometimes asked who is responsible for the articles appearing in these Bulletins. In reply to this it must be said that the Economic Zoologist has personally written every article unless special mention be made to the contrary at the beginning or close of any particular communication. It is true that we have not always read the proof, as the task of preparing the Monthly Bulletins, and being personally responsible for the correspondence of more than fifty letters per day, is such as to preclude the possibility of much proof reading.

In this connection it should be said that every letter and postal card coming into this office is read and answered by the Economic Zoologist in person. We try to be as acccurate in personal correspondence as in the preparation of articles for publication, and for this reason there is no objection to any person publishing any letter sent out from this office, unless it be marked "personal."

Every experiment performed by a representative of this office is first outlined in detail by the Economic Zoologist, and we are in touch with the person or persons performing the experiments, watching the results with care and personally preparing the publications reporting them.

Every bill sent to this office is scrutinized by the Zoologist, and every voucher is signed by him, with the statement that it is correct, before it is sent to the Secretary of Agriculture for further signature and payment. Thus the reader can see that there is something more for the Economic Zoologist to do than to accept the numerous callers that come to him from the various parts of the State to deliver addresses.

We regard our own scientific reputation at stake in each article we write for publication, and also in each letter written, whether it be to a private individual or not, and also in each address delivered. However, we must call the attention of the public to the fact that errors are liable to occur in newspaper accounts, and consequently we do not wish to be held responsible for the accuracy of any newspaper article concerning our views, work or statements, which have not been prepared in this office. Reporters are among the most enthusiastic and well-meaning persons, but as they are not scientists they must necessarily make mistakes due to their misunderstanding and interpretation of a scientific statement or technical fact.

NURSERY INSPECTION IN PENNSYLVANIA.

The nurseries of Pennsylvania are of vast importance. Not only do we grow many more fruit trees than are needed for home use, but in the nurseries of this Commonwealth is grown most of the ornamental stock sold in the eastern part of the United States.

We have a very effectual system of Nursery Inspection, which is proven by the fact that the number of nurseries in which the San José Scale occurred, as found by the State Inspector, has steadily decreased.

However, it is very desirable that our nurseries, and thus, indirectly, the young orchards of our entire State, should be protected by legislation providing to prevent the possibility of constant reinfection from adjoining orchards. To aid in giving this protection we have, during the past year, instituted a system of thorough inspection of premises around nurseries for a radius of about one-half mile, and have sent the owners of infested trees within such area a notification that they must treat their trees, according to our direction or destroy them before April 1st, 1907, as at that time we shall make another inspection of their premises, and in case the work has not been done as directed, and scale is found alive, we shall be obliged, by the requirements of the present law, to give the infested trees or shrubbery such treatment as we find best in accordance with the conditions, or destroy them if they be too badly infested to offer hope of recovery, and charge the owner with the expense of the same by adding it to their tax list, in accordance with the requirements of the law. This makes much additional work for the representatives of this office, but it is of so much service to the nurserymen and indirectly of such very great value to the persons who would plant trees that it is justified.

It is very important that no infested trees be shipped for planting in the orchards of this State, and to prevent this we have pushed with greater care than ever the Nursery Inspection in the State. It has been the custom to commence this Nursery Inspection on the 1st of August, in order to finish it before the digging season and give the nurserymen their certificates permitting them to sell their stock by the time their early fall orders are received. However, we have found that in some cases, there is danger of nurseries becoming infested during the latter part of the summer or early fall, after the inspector has examined them and found them free from San José Scale. This is especially true where there are infested trees growing on property near the nurseries. As reported

above, we are making every effort to remove such sources of infestation to nursery stock, but we also find it necessary to cause a second inspection when the leaves are off the trees, and for this reason we have during the past year made a thorough winter inspection of all nurseries in this State, although they had been inspected before. This was done during the month of February, and the results show the justification and importance of continuing the same. It was found that some nurseries in which the scale did not exist in August had this pest in February, and others which had rid their premises of the scale immediately after the August Inspection and consequently had received certificates permittinng sales, had become re-infested during the early part of the fall and contained the San José Scale to some extent at the February Inspection. The infested trees were again destroyed and the inspectors satisfied themselves, as far as was possible, that the scale did not remain on the nursery stock, when certificates were again given or restored.

It is the custom when San José Scale is found alive on nursery stock to require the destruction of all infested trees within a certain time. A re-inspection is then made without charge to the owner, and if he has succeeded in eliminating all the trees containing scale, he is given a certificate permitting him to sell stock grown in that nursery after having been fumigated according to the prescribed formula of one ounce of Cyanide of Potassium, ninety-eight per cent. pure; two ounces of Sulphuric Acid, 1.83 per cent. specific gravity; and four ounces of water for each one hundred cubic feet of space in the fumigating house, exposing the trees to the deadly gas for a period of forty minutes. Before receiving such a certificate he makes affidavit that he will fumigate his trees. Then a certificate is granted to him, and his trees are considered perfectly safe for sale, shipment and delivery within this State or elsewhere. This is practically the system that is followed in the different states in the Union which have the most effective nursery inspection systems.

However, we have found that the inspectors of some of the other states have either failed to find the San José Scale in certain nurseries in their respective states, or the nurserymen have failed to eliminate it from their premises, and consequently it became decidedly necessary that this State should pass a law providing, as far as possible, against the importation of infested stock. It is impossible for our State to pass laws regulating the actions of growers of nursery stock in other states, and consequently we can not provide against their mistakes in shipping the living scale insects, but we can make it illegal to bring such pests into this State. For this reason provision was made at the last regular session of the Legislature requiring the attachment of a card showing the fumigation

of all nursery stock of varieties to be infested with the San José Scale before it could legally be brought into the State of Pennsylvania by any carrier, express company, railroad or otherwise. In order to have any such stock legally transported it must have at the time of entering the State a tag or certificate attached, stating that it has been fumigated. A few nurserymen in other states have failed to comply with this requirement of our law, and it becomes necessary to watch all shipments with greater care than ever. All persons seeing any packages of nursery stock at any place are requested to examine them and see if they were sent from outside of Pennsylvania, and if so if there be a card or tag attached stating that they have been fumigated. If no such statement be attached, please notify this office at once, giving the name and address of the shipper and also that of the consignee, and also state whether they were sent by express or freight, and what express company or railroad company carried the same.

The system of orchard inspection, which has been perfected by actual practice during the past year, is giving us much important information as to the real spread of the San José Scale in this State, and especially of the places from which it has come. We find that a very large proportion of infested trees actually planted in the young orchards of this Commonwealth are not from Pennsylvania nurseries, but from those outside of this State, which in many instances either have not complied with the requirements of our present law or made their shipments before such provisions were made requiring the destruction of the pests on trees before shipping them.

One source of much evil has been the use of impure materials in fumigation. There is a cheap grade of Cyanide of Potassium which may not have more than fifty or sixty per cent. of Cyanide, and the remainder of its bulk is found to be salts of various kinds, especially Sodium Chloride. It is known that the presence of such salts in Cyanide of Potassium not only prevents the potassium itself from giving the desired amount of gas through reducing the amount of poison that should be used, but it also acts as a deterrent in preventing as much gas to be generated as would have been produced had the salts not been present. In other words, it prevents the perfection of the desired chemical action. Thus the use of a low grade of Cyanide of Potassium will not give enough of the poisonous gas to kill the San José Scale when otherwise the fumigation is directly in accordance with our requirements. The same can also be said of the Sulphuric Acid. It is important that it should be as strong as 1.83 per cent. specific gravity, and it should be measured by the liquid ounce, and not by the ounce in weight. The acid which is less heavy than 1.83 per cent. will not give the desired chemical action nor aid in generating the full amount of gas, even though the Cya-

nide itself should be pure. To avoid trouble from this source we proposed to buy absolutely high grade Cyanide of Potassium and Sulphuric Acid, and furnish these chemicals to the nurserymen at cost, but it was found that objections were made to this plan, because it had the appearance of the State compelling individuals to buy a commodity at only one place and at a fixed price, and consequently the plan was dropped; although we strongly recommend all persons doing fumigating to buy materials of the strengths named above, and only of thoroughly reliable chemists or druggists. There are wholesale druggists who make a specialty of dealing in first class materials, and we shall be glad to give the names and addresses of such firms to those persons who write to this office for them.

We have had one definite case during the past year where the fumigation of a nursery, according to the formula which we have prescribed and for the proper length of time, did not have the desired results. In attempting to learn why the scale was not killed, we questioned the nurseryman concerning the material which he he had used, and he said that he had definitely ordered of the local druggist the Potassium Cyanide of ninety-eight per cent. purity and Sulphuric Acid, 1.83 per cent. specific gravity. He handed the State Nursery Inspector a sample of the material, such as the druggist had furnished to him, and upon analyzing it, we found it to be less than sixty per cent. Cyanide of Potassium. Thus the druggist had failed to deliver the material that was ordered of him, and this justifies us in cautioning nurserymen to be sure of the sources of the material if they wish it to have the desired effect.

In explanation of certain requirements and regulations of this office it should be added that at the time of the second inspection of nurseries the inspector is required to carefully test the fumigating house or box and see if it be properly constructed and tight enough to hold the gas and keep it undiluted and effective during the required period of fumigation.

The following list of nurserymen growing stock in Pennsylvania is complete, as far as we are able to determine. If any person knows of other nurseries in Pennsylvania please notify this office at once. All in this list have been inspected and all have certificates permitting them to make sales, according to law, excepting those marked (†), whose certificates are pending. Those marked (*), do not grow and sell trees, but berry bushes and plants only. This list does not indicate where San José Scale was found, but shows who have certificates and who have not.

Name.	Place.	Acres.
*Frank Smock,	Geneva,	1
*L. L. Wood,	Geneva,	2
*H. C. Carroll,,	Geneva,	1
*Robt. Bennett,	Atlantic,	3
*Peter Schaffner, R. D. No. 2,	Meadville,	1½
*James T. Irwin,	Cochranton,	1½
*Samuel Bailey, R. D. No. 66,	Cochranton,	1
Atkin & Hall, R. D. No. 41,	Linesville,	2½

Dauphin County.

C. P. Scholl, R. D. No. 1,	Halifax,	6
Snavely & Trombine,	Progress,	3
†J. M. Christman,	Fort Hunter,	⅛
Andrew Coble, R. D. No. 1,	Middletown,	2½

Delaware County.

P. Z. Supplee,	Cellingdale,	25
J. J. Styer,	Concordville,	2
M. F. Hannum,	Concordville,	1
W. E. Caum (Lessee),	Haverford,	4
John G. Gardner,	Villa Nova,	5
Wayne Iron Works,	St. Davids,	5
Joseph H. Brinton,	Camp Ground,	½

Erie County.

*A. F. Youngs,	North East,	4
*Orton Bros.,	North East,	5
L. G. Youngs,	North East,	20
*D. C. Bostwick & Son,	Ripley, N. Y.,	9
*M. E. Kelley,	North East,	4
*A. J. Youngs,	North East,	4
*W. E. Smith,	North East,	3
Emil Laurent,	Girard,	2

Fayette County.

J. Sterling & Son,	Masontown,	10

Franklin County.

†J. W. Hefflefinger,	Green Village,	6
J. W. Zook,	Chambersburg,	½
Geo. H. Wert (Forester),	Mt. Alto,	1
Henry Eicholz,	Waynesburg,	1
W. B. Reed,	Chambersburg,	¼

Fulton County.

Eli Covalt,	Covalt,	1

†Certificates pending.
*Grow berry or small fruit plants only.

Juniata County.

Name.	Place.	Acres.
*Elmer W. Graybill,	Richfield,	2
Jos. H. Landis,	McCullough's Mills,	3
*†Augustus Frantz,	Richfield,	1
*†S. H. Graybill,	Richfield,	5

Lackawanna County.

*George H. Colvin,	Dalton,	2
*Floyd H. Northup,	Glenburn,	2
John W. Shepherd,	Scranton,	4
*H. H. Northup,	Dalton,	¼

Lancaster County.

John G. Engle,	Marietta,	6
A. H. Erb,	Lititz,	½
Maurice Brinton,	Christiana,	20
W. P Bolton,	Bonview,	2
D. D. Herr,	Lancaster,	5
H. H. Harnish,	Hubers,	2
†Wilson Kready,	Mt. Joy,	1
†Calvin Cooper,	Bird-in-hand,	2
O. W. Laushey,	Bird-in-hand,	2
A. W. Root & Bro., R. D. No. 1,	Manheim,	20
David S. Herr,	Mountville,	2
M. H. Musser,	Lancaster,	2
M. A. Kolp,	Elizabethtown,	1
B. F. Barr & Co.,	Lancaster,	3
Frank A. Suter,	Lancaster,	½

Lawrence County.

J. W. Hayes, R. D. No. 3,	Edinburg,	1
Butz Bros.,	New Castle,	1
A. S. Moore,	New Castle,	2
D. W. Fisher,	New Wilmington,	1
*Jas. R. Seley,	New Wilmington,	¼
Hover Bros., R. D. No. 63,	New Wilmington,	2

Lehigh County.

W. B. K. Johnson,	Allentown,	30

Luzerne County.

I. A. Driggs,	White Haven,	
(Handles only native ornamental shrubs.)		
M. A. Maffett,	Wilkes-Barre,	1

†Certificates pending.
*Grow berry or small fruit plants only.

The State Nurserymen's Association has been organized to meet this and other important conditions. All nurserymen are invited to become members and profit by it. (Write to the Secretary, Mr. Earl Peters, Mt. Holly Springs, Pa.)

Recognition should be made of the faithful interest and efficiency of the regular nursery inspector, Mr. E. B. Engle, whose desk is in the office of the Economic Zoologist and with whom we have been in constant communication. Inquiries relating to Nursery Inspection may be sent to Inspector Engle, or to the State Zoologist, or to the Secretary of Agriculture, Harrisburg, Pa.

LICENSED TREE DEALERS IN PENNSYLVANIA.

According to recent requirements it is necessary for each Tree Dealer in Pennsylvania, who is not a direct representative of some one nursery only, to procure a certificate from the Department of Agriculture, which, although free, will be given only to persons procuring stock from reliable and certified nurseries.

By the term "Tree Dealer" we refer to persons who make a business of buying nursery stock from various places and selling it again upon his own responsibility or under his own name. Whenever we learn of a tree dealer in this State we ascertain of him the names and addresses of the firms from which he procures his stock, and we then write to the State Nursery Inspectors in the respective States named and learn if the nurseries named have been inspected, and if the firms have in every way complied with the requirements of the law in their States, and if they have a certificate for selling nursery stock according to the regulations of the said State or States. Upon obtaining this information, if all is favorable, a certificate is sent from this office to the tree dealer to sell stock from those nurseries which we have investigated and found to have certificates, but from those only. If it be found that any nursery which the dealer named, in any State whatever, has not complied with the legal requirements of said State and does not have a certificate for the selling of stock in its own State, the tree dealer is refused a certificate to sell stock from that nursery.

We regard the Agent as much different from the Tree Dealer in the fact that the former represents only one firm, which is supposed to be doing legitimate business in its own State, and has been inspected there and holds a certificate, because the owners have conformed to the laws of the State in which they live. Thus the agent

himself does not buy or sell stock, but takes orders for his firm to supply. We have regarded the agent as merely a representative of the firm, and as it is necessary for his firm to have a certificate in order legally to sell any nursery stock in this State, the agent in taking or filling orders for this firm does not need to hold an independent certificate for himself, as he acts under the authority of that held by his certified firm.

Any Tree Dealer in this State should consequently be able to show his certificate from this office, and any agent should have credentials from the nursery which he represents, which he can show, and which must, of course, hold a Certificate of Inspection in the State where the stock is grown in order to make sales in this State.

The following persons have been granted certificates as tree dealers in Pennsylvania, although, under the distinction made above, some may be agents rather than dealers:

ADAMS COUNTY.

R. E. Elden, Aspers, Pa.

ALLEGHENY COUNTY.

W. B. Bockstose, Castle Shannon, Pa.
L. F. Miller, 1023 Garret St., Pittsburg, Pa.
E. C. Hauser, Bellevue, Pa.
Charles Honess, Allegheny, Pa.

BEAVER COUNTY.

J. C. Withrow, Vanport, Pa.
A. E. Crouch, Rochester, Pa.
J. H. Gutermuth, Rochester, Pa.

BEDFORD COUNTY.

J. W. Myers, Everett, Pa.

BERKS COUNTY.

L. M. Neischwender, Hamburg, Pa.
Jacob H. Weand, Reading, Pa.
M. E. Smeltzer, Reading, Pa.
Alfred Dreibelbis, Reading, Pa.

BLAIR COUNTY.

James Hopkins, Juniata, Pa.

BRADFORD COUNTY.

J. F. Gable, Athens, Pa.
Jos. E. Hamilton, R. D. No. 16, Rome, Pa.
J. P. Sibley, R. D. No. 16, Rome, Pa.

BUCKS COUNTY.

A. P. Kratz, Silver Dale, Pa.

BUTLER COUNTY.

Geo. W. Haine, R. D. No. 32, Callery, Pa.

CARBON COUNTY.

Paul Neihoff, Lehighton, Pa.
David N. Rehr, Lehighton, Pa.
L. D. Wagner, Weissport, Pa.

CHESTER COUNTY.

John Alcorn, Malvern, Pa.

CLINTON COUNTY.

W. W. Richie, Lock Haven, Pa.

CRAWFORD COUNTY.

J. C. Boyd, Guy's Mills, Pa.
A. B. Greenfield & Son, Conneautville, Pa.
G. G. Fish, Conneautville, Pa.
F. M. Fleming, Cochranton, Pa.

CUMBERLAND COUNTY.

Ira E. Bigler, Camp Hill, Pa.
D. C. Rupp, Shiremanstown, Pa.
Towzer & Wolff, Carlisle, Pa.

DAUPHIN COUNTY.

A. H. Shreiner, Harrisburg, Pa.
T. A. Woods, Harrisburg, Pa.
Geo. F. Greenawalt, Hummelstown, Pa.
Gilbert Troutman, Millersburg, Pa.

DELAWARE COUNTY.

John Wetherill, Chester, Pa.

ERIE COUNTY.

W. S. Waldo, North East, Pa.
E. E. Carr, North East, Pa.
W. C. Batchelor, Erie, Pa.

LACKAWANNA COUNTY.

Giles L. Clark, Scranton, Pa.
A. J. Noble, Scranton, Pa.

LEBANON COUNTY.

Samuel P. Moyer, Myerstown, Pa.

LEHIGH COUNTY.

N. C. Beachy, Allentown, Pa.
Thos. P. Roth, Orefield, Pa.

LUZERNE COUNTY.

W. H. Lanyan, Hazleton, Pa.

McKEAN COUNTY.

F. S. Palmer, Bradford, Pa.

MONROE COUNTY.

L. D. Eilenberger, E. Stroudsburg, Pa.

MONTGOMERY COUNTY.

John Reig, Jenkintown, Pa.
Wohlert & Waldberg, Bala, Pa.

NORTHAMPTON COUNTY.

T. S. Headman, Seidersville, Pa.

NORTHUMBERLAND COUNTY.

C. H. Weaver, Watsontown, Pa.
H. F. Frank, Montandon, Pa.

PHILADELPHIA COUNTY.

J. R. Giffen, 1826 Willington St., Philadelphia, Pa.

SCHUYLKILL COUNTY.

Walter J. Keller, Pottsville, Pa.
W. O. Snyder, Minersville, Pa.
D. H. Smith, Haas, Pa.
Samuel Buehler, Schuylkill Haven, Pa.

WESTMORELAND COUNTY.

Jos. Thomas, Greensburg, Pa.

YORK COUNTY.

C. H. Snyder, York, Pa.
J. H. Painter, York, Pa.

THE PENNSYLVANIA STATE HORTICULTURAL ASSOCIATION.

The Forty-eighth Annual Meeting of the Penna. State Horticultural Association will be held in Harrisburg, in Chestnut Street Hall, Chestnut St. near Third, Wednesday and Thursday, January 16 and 17, 1907.

Among the persons and subjects on the program are the following:

Mr. J. H. Hale, The Peach Specialist of Conn. and Ga., "Peach Culture."

Mr. L. G. Youngs, North East, Pa., "Peach and Plum Rot and How to Control it."

Mr. J. D. Herr, Inspector and Demonstrator for the Division of Zoology, Millersville, Pa., "Problems of the Small Orchardist."

Hon. W. T. Creasy, Catawissa, Pa., "Apple Growing."

Mr. C. K. Sober, Lewisburg, Pa., "Chestnut Culture in Penna."

Mr. A. W. Fulton, Managing Editor of the American Agriculturist, New York, "Co-operative Marketing of Fruits and Export Trade Possibilities."

Prof. H. A. Surface, State Zoologist, Harrisburg, Pa., "Recent Developments in Scale Remedies."

Mr. D. L. Hartman, New Cumberland, Pa., "Horticulture and Agriculture—A Comparison."

Mr. A. S. Debout, Mgr. Brelsford Packing and Storage Co., Harrisburg, Pa., "Cold Storage and what it Means to the Horticulturist."

Mr. Geo. H. McKay, Philadelphia, Pa., "Varieties of Fruits for Storage."

The report of the General Fruit Committee by Prof. R. L. Watts, Scalp Level, Pa., will be a General Review or Report of Horticulture, Fruit and Crop Statistics, the work of Controlling Injurious Insects and Diseases, and the Results of Horticultural Work in this State during the past year. General discussions of all these topics by members and delegates, and the question box for topics of interest on general horticultural subjects, will be the means of bringing out much practical information.

All persons interested in fruit growing are invited to attend the meetings, ask questions and assist in the discussions. Ladies are specially invited. Local and county organizations in the State and kindred societies elsewhere are invited to send delegates to whom will be accorded privileges of the floor.

An exhibit of fruit, flowers, etc., will be made, and all persons coming are invited to bring specimens of orchard and garden pro-

DEPARTMENT OF AGRICULTURE,
DIVISION OF ZOOLOGY,
H. A. Surface, Economic Zoologist,
HARRISBURG, PA.
P. M.—If not delivered, please return.

uitable exhibition tables will be provided. The
ards will grant Certificates of Merit, signed by
Association, instead of cash prizes.
rmation or card orders giving railroad rates at
, write to the Secretary, Enos B. Engle, Harris-

MEETING OF THE STATE BEE KEEPERS' ASSOCIATION.

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ng of the Pa. State Bee Keepers' Association will
urg, January 17-19, 1907. The first session will
be on the ng of Thursday the 17th, and the last session will adjourn at 11 A. M. on Saturday the 19th. The exhibition of bee products and supplies will be in the State Library and Museum Building, Capitol Park, beside the Capitol Building, and the sessions or meetings of the Association will be held in the Audience Room of the Department of Public Instruction, in the Southeastern corner of the new Capitol building.

The program has been prepared as follows:

THURSDAY EVENING, 7:30 P. M.

Prayer.
Calling of roll.
Reading of minutes of last meeting.
Reception of new members and collection of dues.
Report of Secretary Treasurer, L. R. White, Harrisburg.
Report of Committee on supplies, E. A. Dempwolf, York.
Amendments of Constitution and other Business.
Annual Address of President, Illustrated by Lantern Slides, by Prof. H. A. Surface, Harrisburg.
Eletion of Officers.

FRIDAY, JANUARY 18—Session Beginning at 8:30 A. M.

"Report of the Investigations of Bee Diseases," Dr. E. F. Phillips, in Charge of Apiculture, Washington, D. C.
"Wintering Bees," E. R. Root, Medina, O.
"American Relatives of the Honey Bee," A. F. Satterthwait, Clerk in Division of Zoology, Harrisburg, Pa.
Question Box.

FRIDAY AFTERNOON SESSION—Beginning at 1 P. M.

Business.

"Honey Sales," W. A. Selser, Philadelphia, Pa.

"Bees and Other Things," E. L. Pratt, Swarthmore, Pa.

"Original Features in Commercial Queen Rearing," S. K. Snyder, Lebanon, Pa.

"How to Subdue Bees for Public Exhibitions," E. R. Root, Medina, O. (Illustrated with a Hive of Live Bees.)

Questions and Answers.

FRIDAY EVENING SESSION—Beginning at 7:30 P. M.

Business.

"State Bee Laws," Mr. Chas. Stewart, State Bee Inspector of New York, Sammonsville, N. Y.

"Legislation on Bee Diseases," Dr. E. F. Phillips, in charge of Apiculture, Washington, D. C.

Questions and answers.

SATURDAY MORNING SESSION—Beginning at 8:30 A. M.

"Extracted Honey Production," by Charles M. Green, Troy, Pa.

"Combined Comb Honey Production, Swarm Control and Queen Rearing," E. E. Pressler, Williamsport, Pa.

"Comb Honey Production," C. M. Church, Arnold, Pa.

"Success in Bee Keeping," Charles Stewart, State Inspector of New York, Sammonsville, N. Y.

Reports of Committees.

Questions and Answers.

Final Business and Adjournment at 11 A. M.

In addition to the above program there will be general discussion of numerous subjects which have been proposed by correspondents, as well as abundant opportunities for questions and answers on those subjects in which any person is specially interested.

All persons who keep bees are invited to attend these meetings and join the State Association, and thus become members of the National Association also, receive the publications and benefits of both, with opportunity to purchase bee supplies at special membership discounts, and aid in securing the legislation they need.

Hotel accommodations will be given for $1.50 per day and upward, and can be procured by writing either to the Hershey House, which

will be Headquarters, or to the Secretary of the Association named below, for such help as he can give.

These meetings will be held while the Legislature is in session and persons attending them will have an excellent opportunity to see the new Capitol building and all of the various Departments of the State Government in full activity, as well as both branches of the State Legislature in regular session. Governor Stuart will meet with us if his other engagements will permit.

The card orders, which have been issued by the railroad, granting a rate of one and two-thirds cents per mile, are enclosed to members, and will be sent upon application to all persons wishing to attend our meetings. The time of this excursion is extended to permit coming to Harrisburg for the Governor's Inauguration on Tuesday the 15th, and returning after the various meetings, which are as follows: State Horticultural Meeting, State Bee Keepers' Association, State Board of Agriculture, State Dairymen's Union, and State Live Stock Breeders' Association, meeting in the order named, two days each.

Come and renew your old acquaintance and make new ones. There will be a Committee for Introductions. Ladies especially invited. Bring honey and bee fixtures and supplies for exhibition. Instead of prizes, Certificates of Merit, signed by the officers, will be awarded.

L. R. WHITE, Secretary,
Harrisburg, Pa.

H. A. SURFACE, President,
Harrisburg, Pa.

ANNUAL MEETING OF THE STATE BOARD OF AGRICULTURE.

The Annual Meeting of the State Board of Agriculture of Penna. will be held in the Capitol building, Harrisburg, Tuesday and Wednesday, January 22nd and 23rd. The following Program has been prepared:

Tuesday Morning, January 22, 1907.

Reports of Specialists and Standing Committees:
Botanist, Prof. W. A. Buckhout, State College, Pa.
Pomologist, Dr. J. H. Funk, Boyertown, Pa.
Committee on Fruit and Fruit Culture, J. F. Boyer, Chairman, Freeburg, Pa.

Committee on Live Stock, Dr. E. E. Tower, Chairman, Hop Bottom, Pa.
Discussion of Reports.
Report of Committee on Credentials.
Unfinished Business.
New Business.

Tuesday Afternoon.

Reports of Specialists and Standing Committees, Continued:
Veterinarian, Dr. Leonard Pearson, Philadelphia, Pa.
Apiarist, Prof. Geo. C. Butz, State College, Pa.
Committee on Apiary, J. W. Nelson, Chairman, Shawville, Pa.
Sanitarian, Dr. Edward Patrick, West Chester, Pa.
Committee on Roads and Road Laws, D. A. Knuppenburg, Chairman, Lake Carey, Pa.
Committee on Wool and Textile Fibres, D. S. Taylor, Chairman, Raccoon, Pa.
Discussion of Reports.
"Building up a Dairy Herd," Edward Van Alstyne, Kinderhook, N. Y.

Tuesday Evening.

Reports of Specialists and Standing Committees, Continued:
Microscopists and Hygienists: Prof. C. B. Cochran, West Chester, Pa.; Dr. Geo. G. Groff, Lewisburg, Pa.
Entomologists: Prof. H. A. Surface, Harrisburg, Pa.; Prof. Franklin Menges, York, Pa.
Committee on Poultry: Dr. M. E. Conard, Chairman, West Grove, Pa.
Discussion of Reports.
"Agricultural Education," Hon. Wm. M. Hays, Asst. Secty. of Agr., Washington, D. C.; Prof. H. E. VanNorman, State College, Pa.; E. S. Bayard, Edtr. National Stockman and Farmer, Pittsburg, Pa.

Wednesday Morning, January 23rd, 1907.

Reports of Specialists and Standing Committees, Continued:
Chemist: Dr. Wm. Frear, State College, Pa.
Mineralogist: Col. H. C. Demming, Harrisburg, Pa.
Ornithologist: Prof. H. A. Surface, Harrisburg, Pa.
Committee on Fertilizers: Hon. H. G. McGowan, Chairman, Geiger's Mills, Pa.
Meteorologist: E. R. Demain, Harrisburg, Pa.

Discussion of Reports.
Address by Prof. Thos. F. Hunt, State College, Pa.
Election of Officers.

Wednesday Afternoon.

Report of Executive Committee.
Reports of Specialists and Standing Committees, Continued:
Committee on Floriculture: Edwin Lonsdale, Chairman, Girard College, Philadelphia, Pa.
Committee on Forestry: James M. Piatt, Chairman, Tunkhannock, Pa.
Committee on Cereals and Cereal Crops: S. X. McClellan, Knox, Pa.
Committee on Feeding Stuffs: F. D. Fuller, Chairman, Harrisburg, Pa.
Discussion of Reports.
"Systems of Permanent Soil Improvement vs. Land Ruin," Prof. Cyril G. Hopkins, Urbana, Ill.

Wednesday Evening.

Joint Meeting of State Board of Agriculture of Pennsylvania.
Live Stock Breeders' Association, and Pennsylvania Dairy Union.
Report of Committee of Identification of Fruit:
Committee, Dr. J. H. Funk, John F. Boyer and A. I. Weidner.
Report of Committee of Identification of Vegetables:
Committee, Joel A. Herr, Geo. G. Hutchison and Sam'l McCreary.
Report of Committee on Legislation:
Hon. A. J. Kahler, Chairman, Hughesville, Pa.
Report of Geologists, Col. H. C. Demming, Harrisburg, Pa., and W. H. Stout, Pine Grove, Pa.
"Calf Feeding," E. A. Norton, Waymart, Pa.
"Animal Breeding," Hon. W. M. Hays, Washington, D. C.
"Rational Feeding," Edw. Van Alstyne, Kinderhook, N. Y.

For a copy of the program and card orders for excursion rates write to the Secretary of Agriculture, Harrisburg, Pa.

PENNSYLVANIA LIVE STOCK BREEDERS' ASSOCIATION AND PENNSYLVANIA DAIRY UNION.

The Pennsylvania Live Stock Breeders' Association and the Pennsylvania Dairy Union will hold their Annual Meeting in Harrisburg on January 24 and 25th. The following program has been prepared:

Thursday Forenoon, January 24th, 1907.

Call to order at 9:00 o'clock.

The Pennsylvania Live Stock Breeders' Association and the Pennsylvania Dairy Union will hold separate sessions during this period, the respective Programs being as follows:

Breeders' Association.

1. Reports of Officers and Committees.
2. "Pork-Making in the East," Prof. Harry Hayward, Director of Delaware Experiment Station, Newark, Del.
3. "Pennsylvania Stockman and Meat Inspection Law," Prof. Thos. F. Hunt, Director of Pennsylvania Experiment Station and Dean of Agriculture, State College, Pa.
4. "The Golden Hoof," Joseph E. Wing, Mechanicsburg, Ohio.

Dairy Union.

Creamery Session.

"Butter Scoring Demonstration," P. H. Keifer, New York.

To be followed by discussion of Starters, Butter Making, etc.

Thursday Afternoon.

Call to order at 1:30 o'clock.

Joint Session of Pennsylvania Live Stock Breeders' Association and Pennsylvania Dairy Union.

1. Address of President of Dairymen, Prof. H. E. Van Norman, State College, Pa.
2. Address, by E. H. Webster, Chief of Dairy Division, Dept. of Agri., Washington, D. C.
3. Address, by Ex-Gov. W. D. Hoard, Ft. Atkinson, Wis.
4. "Relation of the Veterinary School to the Farmer," Dr. Leonard Pearson, State Veterinarian.
5. "A Profitable Method of Marketing Milk," J. H. Reichert, Scranton, Pa.

Thursday Evening.

Call to order at 7:30 P. M.

Joint session of Pennsylvania Live Stock Breeders' Association and Pennsylvania Dairy Union.

1. Legislation:
   a. State Fair.
   b. Dairy Sanitary Inspection.
   A short discussion of the above subjects, open to all.
2. "Corn Growing," with demonstration, Prof G. I. Christie, Indiana Experiment Station, Lafayette, Ind.
3. "How to Grow Alfalfa," Joseph E. Wing, Mechanicsburg, Ohio. Discussion of above subject, opened by Ex. Gov. W. D. Hoard, of Wisconsin.

Friday Morning, January 25th, 1907.

Joint session of Pennsylvania Live Stock Breeders' Association and Pennsylvania Dairy Union.

1. Unfinished Business.
2. Election of Officers.
3. Awarding of Premiums.

PENNSYLVANIA FARMERS' INSTITUTES DURING JANUARY, 1907.

During this month Farmers' Institutes are being held in many of the different counties of this State, and specialists are attending these Institutes in the capacity of Lecturers, who are able to answer questions concerning various features of agriculture, farm management, crops, pests, plant diseases, etc.

It will be well to take twigs supposed to be infested with San José Scale and other pests to the Institute and let the speakers examine and give advice upon the same.

The series of Institutes arranged for this month in this State are open to the public, both day and night, and no charges are made nor are any collection taken.

The services are free and are arranged in six sections as follows:

FIRST SECTION.

L. W. Lighty and Dr. J. H. Funk will attend all meetings in this section.

Date.	Place.	County.	Additional Lecturers.
Jan. 1,	Hogestown,	Cumberland,	Henry W. Northup.
Jan. 2,	Churchtown,	Cumberland,	Henry W. Northup and Norman G. Miller.
Jan. 3,	Plainfield,	Cumberland,	Henry W. Northup.
Jan. 4,	Newburg,	Cumberland,	Henry W. Northup.
Jan. 5,	Jacksonville,	Cumberland,	Henry W. Northup.
Jan. 7-8,	Berrysburg,	Dauphin,	Henry W. Northup.
Jan. 9-10,	Linglestown,	Dauphin,	Henry W. Northup and Norman G. Miller.
Jan. 11-12,	Hershey,	Dauphin,	Henry W. Northup and J. D. Detrich.
Jan. 12,	Campbelltown,	Lebanon,	Henry W. Northup.
Jan. 14-15,	Jonestown,	Lebanon,	Henry W. Northup and A. B. Lehman.
Jan. 16-17,	Schaefferstown,	Lebanon,	Henry W. Northup and A. B. Lehman.
Jan. 18-19,	Ephrata,	Lancaster,	Henry W. Northup and A. B. Lehman.
Jan. 28-29,	Fawngrove,	York,	W. F. Hill.
Jan. 30-31,	Loganville,	York,	W. F. Hill.

SECOND SECTION.

J. H. Peachey will attend all meetings in this section; Dr. I. A. Thayer, December 3 to Jan. 17; J. P. Pillsbury, Jan. 28 to Feb. 9.

Date.	Place.	County.	Additional Lecturers.
Dec. 31-Jan. 1,	Belleville,	Mifflin,	D. H. Watts.
Jan. 2-3,	Thompsontown,	Juniata,	D. H. Watts.
Jan. 4-5,	East Waterford,	Juniata,	D. H. Watts.
Jan. 7,	Ickesburg,	Perry,	Joel A. Herr and Mrs. Sarah B. Fritz.
Jan. 8-9,	Blain,	Perry,	Joel A. Herr, and Mrs. Sarah B. Fritz.
Jan. 10-11,	Liverpool,	Perry,	Joel A. Herr, and Mrs. Sarah B. Fritz.
Jan. 12,	Selinsgrove,	Snyder,	Joel A. Herr and Mrs. Sarah B. Fritz.
Jan. 14-15,	Middleburg,	Snyder,	Joel A. Herr.
Jan. 16-17,	Beavertown,	Snyder,	Joel A. Herr.
Jan. 28-29,	New Columbia,	Union,	J. O. Smith and Horace H. Hall.
Jan. 30-31,	Buffalo X Roads,	Union,	J. O. Smith and Horace H. Hall.

THIRD SECTION.

J. S. Burns will attend all meetings in this section; Dr. H. P. Armsby, Dec. 31 to Jan. 12; Dr. Wm. Frear, Jan. 14 to 19; Prof. Wells W. Cooke, Jan. 28 to March 9.

Date.	Place.	County.	Additional Lecturers.
Dec. 31-Jan. 1,	Midway,	Washington,	G. B. Waychoff and M. N. Clark.
Jan. 2-3,	Buffalo,	Washington,	G. B. Waychoff and M. N. Clark.
Jan. 4-5,	Jacksonville,	Greene,	G. B. Waychoff and M. N. Clark.
Jan. 7,	Aleppo,	Greene,	G. B. Waychoff and F. J. Wagner.
Jan. 8-9,	Oak Forest,	Greene,	G. B. Waychoff and F. J. Wagner.
Jan. 10-11,	Centreville,	Washington,	G. B. Waychoff and F. J. Wagner.
Jan. 14-15,	Flatwoods,	Fayette,	G. B. Waychoff and W. M. C. Drake.
Jan. 16-17,	Sandyhill,	Fayette,	G. B. Waychoff and W. M. C. Drake.
Jan. 18-19,	Mill Run,	Fayette,	G. B. Waychoff and W. M. C. Drake.
Jan. 28-29,	Scottdale,	Westmoreland,	G. B. Waychoff and W. M. C. Drake.
Jan. 30-31,	Export,	Westmoreland,	G. B. Waychoff and W. M. C. Drake.

FOURTH SECTION.

R. S. Seeds will attend all meetings in this section; Prof. Geo. C. Butz, Dec. 3 to Jan. 5; Prof. M. S. McDowell, Jan. 7 to March 2.

Date.	Place.	County.	Additional Lecturers.
Jan. 1,	Armstrong School House,	Beaver,	J. T. Campbell.
Jan. 2-3,	Mt. Pleasant,	Beaver,	J. T. Campbell.
Jan. 4-5,	Church of God,	Beaver,	J. T. Campbell.
Jan. 7-8,	Conoquenessing,	Butler,	J. T. Campbell.
Jan. 9-10,	Sarversville,	Butler,	J. T. Campbell.
Jan. 11-12,	Eau Claire,	Butler,	J. T. Campbell.
Jan. 15-16,	Utica,	Venango,	J. T. Campbell and E. L. Phillips.
Jan. 17-18,	Breedtown,	Venango,	J. T. Campbell and E. L. Phillips.
Jan. 19,	Chandler's Valley,	Warren,	J. T. Campbell and E. L. Phillips.
Jan. 28-29,	Lander,	Warren,	Geo. E. Hull.
Jan. 30-31,	Sugargrove,	Warren,	Geo. E. Hull.

FIFTH SECTION.

Prof. Franklin M. nges will attend all meetings in this section; Dr. E. E. Tower, Dec. 3 to Jan. 19; S. F. Barber, Jan. 28 to Feb. 28.

Date.	Place.	County.	Additional Lecturers.
Dec. 31-Jan. 1.	Warren Centre, ...	Bradford, ...	W. H. Stout and R. P. Kester.
Jan. 2-3,	North Orwell, ...	Bradford, ...	W. H. Stout and R. P. Kester.
Jan. 4-5,	Herricksville, ...	Bradford, ...	W. H. Stout and R. P. Kester.
Jan. 7-3,	East Troy, ...	Bradford, ...	W. H. Stout and R. P. Kester.
Jan. 9,	East Smithfield, ...	Bradford, ...	W. H. Stout and R. P. Kester.
Jan. 10-11,	Meshoppen, ...	Wyoming, ...	W. H. Stout and R. P. Kester.
Jan. 12,	Lovelton, ...	Wyoming, ...	W. H. Stout and R. P. Kester.
Jan. 14,	Tunkhannock, ...	Wyoming, ...	R. L. Beardslee.
Jan. 15-16,	Rutland, ...	Tioga, ...	R. L. Beardslee and C. W. Brodhead.
Jan. 17-18,	Little Marsh, ...	Tioga, ...	R. L. Beardslee and C. W. Brodhead.
Jan. 19,	Osceola, ...	Tioga, ...	R. L. Beardslee and C. W. Brodhead.
Jan. 28-29,	McElhatten, ...	Clinton, ...	C. W. Brodhead and A. J. Kahler.
Jan. 30-31,	Millhall, ...	Clinton, ...	C. W. Brodhead and A. J. Kahler.

SIXTH SECTION.

Hon. T. J. Philips will attend all meetings in this section; Prof. Wells W. Cooke, Dec. 4 to Jan. 19; Dr. I. A. Thayer, Jan. 28 to March 9.

Date.	Place.	County.	Additional Lecturers.
Dec. 31,-Jan. 1,	Centre Point, ...	Montgomery, ...	R. F. Schwarz and Dr. H. B. Bashore.
Jan. 2-3,	Pineville, ...	Bucks, ...	R. F. Schwarz and Dr. H. B. Bashore.
Jan. 4-5,	Lower Saucon, ...	Northampton, ...	R. F. Schwarz and Dr H. B. Bashore.
Jan. 7-8,	King of Prussia, ...	Montgomery, ...	R. F. Schwarz.
Jan. 9-10,	Langhorne, ...	Bucks, ...	R. F. Schwarz and J. D. Detrich.
Jan. 11-12,	Ackermanville, ...	Northampton, ...	R. F. Schwarz.
Jan. 14-15,	Sanatoga, ...	Montgomery, ...	R. F. Schwarz.
Jan. 16-17,	Sellersville, ...	Bucks, ...	R. F. Schwarz.
Jan. 18-19,	Bath, ...	Northampton, ...	R. F. Schwarz.
Jan. 28-29,	Plumsteadville, ...	Bucks, ...	R. F. Schwarz.
Jan. 30-31,	Harleysville, ...	Montgomery, ...	Prof. W. F. Massey.

ACKNOWLEDGEMENT OF DONATED SPECIMENS.

To our many friends who have aided our studies of the Fauna of Pennsylvania by contributing specimens, the Zoologist acknowledges, with sincere thanks, obligations for specimens named in the following lists, arranged according to respective months of receipt. This does not include the lists of specimens collected by our official assistants:

Specimens Received During July—Concluded.

Number.	Specimen.	Date—July, 1906.	Name and Address.
	Birds and Mammals.		
6880	(a) Baltimore Oriole,	7	W. K. Warden, Oxford.
6892	Robin,	10	Dr. J. H. Kalbfus, Harrisburg.
6916	Jumping Mouse (Z. hudsonius),	13	M. Couch, Hickory.
6929	Common Mole (S. aquaticus),	14	W. S. Hugett, Alexandria.
6986	(d) Brown Bat (V. fuscus),	19	R. L. Jackson, McConnellsburg.
7000	(a) Catbird, (b) 2 Baltimore Orioles,	21	C. L. Brumbaugh, Wilkinsburg.
7011	Meadowlark,	23	E. R. Mulford, Wellsboro.
7077	Star-nosed Mole,	28	Mrs. J. W. Atkinson, Buckingham.
7087	Robin,	30	C. L. Brumbaugh, Wilkinsburg.
7089	2 Purple Martins,	30	R. W. Wehrle, Indiana.
7090	Meadow Mouse (M. pennsylvanicus),	30	J. Muthler, Beech Creek.

Specimens Received During August, 1906.

Number.	Specimen.	Date—August, 1906.	Name and Address.
	Insects.		
7102	Wire Worms,	1	W. L. McCracken, Brookville.
7103	Psocids,	1	W. G. Winner, Calvert.
7104	(a) San José Scale,	1	J. J. Reitz, Walnutport.
7108	Insects,	1	L. Bean, Emlenton.
7112	Work of Curculio,	1	J. T. Bradley, Middletown.
7116	Swallow-tail Larvæ (P. turnus),	2	E. R. Mulford, Wellsboro.
7117	Psocids,	2	E. Oppenlander, Passer.
7118	Cecropia Larva,	2	G. B. Barr, Roulette.
7119	(a) Oyster-shell Scale, (b) Fall Webworm,	2	O. L. Hall, Keating Summit.
7120	(a) Oyster-shell Scale,	2	J. H. Alcorn, Titusville.
7122	San José Scale,	2	F. Corss, Kingston.
7125	Parasitic Wasp (T. lunator),	2	J. Keener, Van Voorhis, W. Va.
7136	Lecanium,	3	C. E. Mausell, Laceyville.
7137	Maple Pseudococcus,	3	J. K. McLanahan, Hollidaysburg.
7138	Twelve-spotted Diabrotica,	3	J. Russel, Overbrook.
7146	Imperial Moth,	4	T. Fennell, Cannelton.
7147	Psocids,	4	A. H. Mast, Elverson.
7149	Psocids,	4	S. M. Arnold, Jr., Clarion.
7150	Dogbane Beetle,	4	D. S. Emerick, Reading.
7154	Halisidota Larvae,	6	G. A. Spring, Covington.
7157	Halisidota Larva,	6	H. C. Fuller, Leominster, Mass.

Specimens Received During August—Continued.

Number.	Specimen.	Date—August, 1906.	Name and Address.
7159	Yellow-necked Datana,	6	D. R. Sumstine, Wilkinsburg.
7160	Cecidomyia Galls,	6	D. E. Jones, Scranton.
7162	Oyster-shell Scale,	6	A. S. Peterson, Franklinville.
7164	Collection of 11 species,	6	E. L. Johnston, Evans, Col.
7169	Polyphemus Moth,	6	M. Douglass, Harrisburg.
7174	Scurfy Scale,	7	A. D. Plank, Morgantown.
7175	(a) Lecanium, (b) Cottony Maple Scale,	7	E. M. Hawkins, Steelton.
7176	Beetle (T. canellus),	7	M. D. Yoder, Hegins.
7177	(a) San José Scale, (b) Shot-hole Borers,	7	I. Chapin, Shickshinny.
7179	Maple Pseudococcus,	7	I. L. Kinney, Portland.
7180	Oyster-shell Scale,	7	G. T. Hoffman, Phoenixville.
7181	(a) Geometrid Larvae, (b) Halisidota Larva,	7	C. E. Denniston, Okome.
7183	Dobson Fly,	7	J. S. Raesly, Mount Bethel.
7184	San José Scale,	7	J. C. Miller, Dover.
7186	Wooly Aphis on Maple,	8	F. Adams, Mansfield.
7187	Walking Stick,	8	F. M. Arnold, Jr., Clarion.
7189	(a) Prominent Larvæ (D. integerrima). (b) Prominent Larvæ (D. ministra),	8	F. S. Andrews, Wellsboro.
7192	Lepidoptera larva,	8	D. N. Kern, Allentown.
7193	Wheat Joint Worms,	8	F. Anderson, Geneva.
7195	San José Scale,	8	A. B. Thorn, Clearfield.
7196	(a) Spotted Pelidnota,	8	E. Walhay, Bendersville.
7198	Red-humped Apple Worm,	8	H. Roblyer, Wellsboro.
7200	Dogday Cicada,	8	Mrs. H. S. Byerts, Siddonsburg.
7201	Insects,	8	H. Barrington, Harrisburg.
7204	Datana integerrima,	9	C. E. Wagner, Westover.
7205	(a) Lecanium tulipifera, (b) Oyster-shell Scale,	9	J. K. Ditchert, East Bangor.
7208	Oyster-shell Scale,	9	W. H. Leslie, Arnold.
7210	San José Scale,	9	S. J. Barnett, Delta.
7213	(d) Luna Moth,	9	R. L. Jackson, McConnellsburg.
7215	Scurfy Scale,	10	H. H. Sipes, Freeport.
7216	San José Scale,	10	J. D. Zettelmoyer, Whitedeer.
7218	Red-humped Apple Worm,	10	F. N. Hines, Spring Creek.
7222	Work of Seventeen-year Cicada,	10	J. R. McMillan, Gettysburg.
7224	Tomato Sphinx Larva,	11	A. W. Stineruck, Middletown.
7225	Cecropia Larva,	11	M. A. Brandt, Chambersburg.
7226	Basket Worms,	11	Mrs. A. Blaker, Newtown.
7227	Saddle-back Larvæ,	11	S. Springer, Harrisburg.
7229	Insects,	11	G. A. Spring, Covington.
7231	(a) Coleoptera Larvæ, (b) Cynip Gall,	11	C. P. Dadant, Hamilton, Ill.
7238	(a) San José Scale, (b) Scurfy Scale,	13	H. Shultz, Huntingdon.
7239	(a) Luna Moth, (b) Cecropia Cocoon,	13	G. M. Lehman, Essington.
7247	Leaf Beetle (P. canellus),	13	E. Kasson, Tunkhannock.
7255	Insects,	13	C. Anderson, Harrisburg.
7258	Polyphemus Moth,	14	B. Laufle, Harrisburg.
7260	Insects,	14	R. W. Wehrle, Indiana.
7263	(a) Oyster-shell Scale, (b) Yellow-necked Datana,	14	I. Gahagan, Trade City.
7265	Shot-hole Borers,	14	C. C. Ziegenfuss, Easton.
7266	Papilio troilus,	14	J. E. Patterson, Wilkes-Barre.
7267	Cecropia Larva,	14	G. W. Hazelton, Ambler.
7270	Lady Bugs (P. misella),	15	C. L. Gruber, Kutztown.
7271	Insects,	15	Miss L. Dale, Wellsboro.
7272	San José Scale,	15	J. M. Wallace, Finleyville.
7279	Fall Webworm,	16	C. A. Wertz, Bedford.
7281	Slug (P. pithecium),	16	E. E. Hess, West Willow.
7282	San José Scale,	16	J. A. Fackler, Linglestown.
7283	Oyster-shell Scale,	16	P. L. Carpenter, Johnstown.
7284	(a) San José Scale, (b) Notodontid Moth,	16	J. O. Brady, Elliottson.
7285	San José Scale,	16	B. R. Kolb, Sassamansville.
7286	Saddle-back Larvae,	16	H. Barrington, Harrisburg.
7289	Dogday Cicada,	17	C. B. Steele, Tioga.
7290	(a) San José Scale,	17	H. F. Rosenberger, Allentown.
7291	Dogday Cicada,	17	A. J. Beck, Harrisburg.
7293	(a) Oyster-shell Scale,	17	J. S. Hunter, Grove Summit.
7297	Five-spotted Tomato Sphinx,	17	A. B. Champlain, Harrisburg.
7300	Bumble Flower Beetle (E. inda),	17	R. E. Klinger, Erdman.
7309	(a) Io Moth Larva, (b) Rosy Maple Larva,	18	Mrs. J. W. Atkinson, Buckingham.
7310	(a) Scurfy Scale, (b) Dogday Cicada,	18	T. E. Moore, Grampian.

Specimens Received During August—Continued.

Number.	Specimen.	Date—August, 1906.	Name and Address.
7311	Magnolia Lecanium,	18	C. P. Hale, Philipsburg.
7314	Five-spotted Sphinx,	18	J. R. Britton, Lititz.
7318	(c) Arctiid Larva,	20	C. E. Denniston, Okome.
7319	Io larva,	20	J. E. Bird, Dushore.
7320	Red-humped Apple Larva,	20	B. Gilkinson, Waterford.
7323	Io Larva,	20	J. H. Stiltz, Braddock.
7325	Magnolia Lecanium,	20	F. D. Leete, Emporium.
7326	Aphids,	20	Dr. F. Corss, Kingston.
7329	Insects,	20	A. Champlain and H. B. Kirk, Harrisburg.
7331	Saddle-back Larva,	20	S. G. Bowman, Mechanicsburg.
7333	Tobacco Pod Worm,	20	John S. Weaver, Kinzers.
7335	Saddle-back Larvae,	20	F. W. Peifer, Fishers Ferry.
7336	Sphinx Larvæ (P. pandorus),	21	D. W. Navle, Wellsboro.
7340	Bumble Flower Beetle (E. inda),	21	C. L. Thornburg, S. Bethlehem.
7341	Thalessa atra,	21	H. W. Coryell, Nichols, N. Y.
7345	Insects,	21	J. P. F. Brunner, Krumsville.
7348	(a) San José Scale, (b) Putman's Scale,	21	O. D. Schock, Hamburg.
7352	(a) Lecanium, (b) Hallsodota caryae, (c) Cone-headed Grasshopper (C. ensiger).	22	W. H. Bullock, Honesdale.
7353	Lappet Moth Larva (T. velleda),	22	L. Stewart, Oakdale.
7354	Hickory Horned Devil,	22	J. S. Farver, Elizabethtown.
7355	San José Scale,	22	W. K. Graber, Bethlehem.
7356	(a) Saddle-back Larvæ, (b) Leaf-eating Lady Bugs (E. borealis).	22	N. B. Dana, Conshohocken.
7359	(b) Horse Flies,	22	F. S. Henry, Philadelphia.
7360	Tussock Moth,	22	S. Kepperley, New Bloomfield.
7370	Hickory Horned Devil,	23	W. H. Keener, Adah.
7372	Walking Stick,	23	G. R. L. Smith, Corydon.
7373	(a) Cecropia Cocoon, (b) Polyphemus Cocoon,	23	M. S. Cunningham, Chambersburg.
7376	Tussock Moth Larva,	23	Mrs. J. Feicht, Reynoldsville.
7383	Cecropia Larva,	23	J. Meck and B. Campbell, Harrisburg.
7384	Hickory Horned Devil,	23	W. J. Rose, Harrisburg.
7391	Saddle-backed Larva,	23	C. Winn, Harrisburg.
7392	Saddle-backed Larva,	23	Miss Eby, Harrisburg.
7393	Yellow-bordered Water Beetle,	24	L. W. Smedley, Wellsboro.
7395	Yellow-bordered Water Beetle,	24	D. B. Holiday, Crooked Creek.
7396	Cecropia Cocoon,	24	C. E. Grim, Windsor.
7398	Mole Cricket,	24	T. Nesbit, Utica.
7400	(a) Walking Stick, (b) Aphids,	24	T. Oxford, Jr., N. Bangor.
7401	San José Scale,	24	J. G. Prizer, Schwenksville.
7402	Saddle-back Larvae,	24	W. C. Shoemaker, Huntingdon.
7404	Imperial Moth Larva,	24	J. A. Patterson, Stewartstown.
7406	Cecropia Larva,	24	A. J. Schubert, Johnstown.
7407	Saddle-back Larva,	25	D. W. Bortz, Esterly.
7408	Thalessa lunator,	25	J. Folk, Bellefonte.
7410	Giant Water Bug (B. griseus),	25	H. E. Smith, Parkesburg.
7411	Warble,	25	P. R. Boltz, Lebanon.
7412	Datana integerrima,	25	F. S. Andrews, Wellsboro.
7414	San José Scale,	25	H. J. Reeser, Bethlehem.
7415	Bumble Flower Beetle (E. inda),	25	W. O. Lentz, Mauch Chunk.
7416	Five-spotted Sphinx Larva,	25	J. W. Eldred, Waynesburg.
7417	Lepidoptera Larva,	25	H. S. Bitner, Millersville.
7419	Dogday Cicada,	25	C. I. Blair, Aspers.
7421	Scurfy Scale,	27	H. H. Cumings, Madison.
7424	Datana integerrima,	27	I. J. Focht, Wellsboro.
7425	Saddle-back Larvae,	27	Standard Office, Milton.
7428	Bumble Flower Beetle (E. inda),	27	L. A. Sterner, Allentown.
7430	San José Scale,	27	F. L. Kanselman, Cool Spring.
7434	Insects,	27	H. Barrington, Harrisburg.
7436	Five-spotted Sphinx,	27	C. Anderson, Harrisburg.
7437	Maple pseudococcus,	27	C. A. Hempt, Camp Hill.
7441	Walking Stick,	28	G. A. Stahl, Pennsburg.
7442	(b) Aphids,	28	W. G. Winner, Calvert.
7444	Cecropia Larva,	28	M. C. Brightbill, Marsh Run.
7445	Hickory Horned Devil,	28	W. H. Lightner, Shrleysburg.
7446	(a) Bluet Butterfly (L. comyntas), (b) Moth (Utetheisa bella),	28	C. H. Knipe, Marietta.
7447	Blister Beetle (E. pennsylvanica),	28	F. Goodfellow, Hollidaysburg.
7448	Wooly Aphis,	28	E. B. Cope, Kennett Square.
7450	Mole Cricket,	28	S. Lick, Marysville.
7451	(a) Polyphemus, (b) Five-spotted Sphinx,	28	O. N. Kaltriter, Mt. Pleasant.
7452	Oyster-shell Scale,	28	J. C. Crone, Titusville.
7453	Euphoria inda,	28	J. Parker, Sebring.

Specimens Received During August—Continued.

Number.	Specimen—Insects.	Date—August, 1906.	Name and Address.
7459	Shot-hole Borers,	28	H. A. Hufford, Amity.
7462	Oyster-shell Scale,	28	I. C. Williams, Harrisburg.
7463	(b) Apatelodes torrefacta, (c) Euphoria inda,	29	W. H. Bullock, Honesdale.
7465	Sphinx Larva (P. pandorus),	29	G. Erk, Seelyville.
7469	Maple Lecanium,	29	F. A. Kelser, Scranton.
7470	Hickory Horned Devil (C. regalis),	29	G. W. Yont, Osterburg.
7473	Polyphemus Larva,	29	J. P. Umholtz, Berrysburg.
7474	Fall Webworm,	29	A. B. Thompson, Mercer.
7477	(a) Dogday Cicada, (b) Five-spotted Sphinx, (c) Cecropia Larva,	29	C. Louis and G. Welsh, Harrisburg.
7478	Saddle-back Larva,	30	S. E. Bushong, Lititz.
7479	(a) Scurfy Scale,	30	S. M. Robinson, McConnellsburg.
7480	Io Larvae,	30	F. S. Henry, Philadelphia.
7482	Imperial Larva,	30	O. K. Hartman, Adamstown.
7483	Io Larva,	30	O. W. Greenman, Oswayo.
7486	Lachnosterna Larva,	30	H. Barrington, Harrisburg.
7489	(a) San José Scale, (b) Scurfy Scale,	30	C. A. Fishinger, Steelton.
7498	Catalpa Sphinx,	31	R. J. Jolly, Cedarville.
7500	Scurfy Scale,	31	J. H. Johnson, Smiths Ferry.
7502	Katydid Eggs,	31	A. C. Rutter, Perkasie.
7503	Walking Stick,	31	W. K. Johnston, Ansonville.
7504	(a) Blister Beetle (E. pennsylvanica)	31	Miss M. Fulton, Carlisle.
7505	Red-humped Apple Larva,	31	F. Segling, Eldred.
7506	Syrphid Fly Pupa,	31	L. B. Palmer, Blacklick.
7507	Dogday Cicada,	31	R. Fulton, Clearfield.
7511	(a) Larva of Sphinx, (b) Saddle-back Larvae, (c) Bumble Flower Beetle, (d) Io Larva,	31	E. and A. Hartwick and R. DeHart, Harrisburg.
7513		31	M. C. Brightbill, Marsh Run.
7514	Cecropia Larva,	31	J. W. Hefflefinger, Green Village.
	Invertebrates Not Insects.		
7104	(b) Red Mites,	1	J. J. Reitz, Walnutport.
7120	(c) Mites,	2	J. H. Alcorn, Titusville.
7164	(c) Mite Galls,	6	E. L. Johnston, Evans, Col.
7206	Slugs,	9	Mrs. J. A. Williams, Sayre.
7213	(c) Millipede,	9	R. L. Jackson, McConnellsburg.
7233	(c) Red Mites,	13	H. Shultz, Huntingdon.
7255	(b) Gordius,	13	C. Anderson, Harrisburg.
7269	Mites,	14	C. L. Thornburg, S. Bethlehem.
7280	Garden Spiders,	16	Mr. Gregg, Wormleysburg.
7318	(b) Crayfish,	20	C. E. Denniston, Okome.
7324	Garden Spider,	20	G. Baldwin, Parkesburg.
7359	(a) Garden Spiders,	27	F. S. Henry, Philadelph'a.
7374	Garden Spider,	23	C. B. Steele, Tioga.
7375	Nematodes,	23	H. P. Welsbrod, Dushore.
7409	Millipede,	25	J. E. Bird, Dushore.
7467	(a) Spiders,	29	G. A. Maeder, Altoona.
7475	Spiders,	29	R. Grahm, Harrisburg.
7508	Mites,	31	E. H. Bonsall, Glenolden.
	Fishes, Batrachians and Reptiles.		
7106	2 Rattlesnakes,	1	J. H. Drill, Cogan House.
7107	Rattlesnakes,	1	C. E. Denniston, Okome.
7108	Blacksnake,	1	L. Bean, Emlenton.
7109	2 Common Water Snakes,	1	W. H. Bullock, Honesdale.
7112	Common Garter Snake,	2	R. E. Harley, Pottstown.
7129	Blacksnake,	2	W. H. Bullock, Honesdale.
7135	House Snake,	3	E. R. Mulford, Wellsboro.
7139	Eggs of Ring-necked Snake,	3	K. W. Mierley, Mapleton Depot.
7141	Blacksnake,	3	H. Drill, Cogan House.
7145	(a) 2 Pilot Snakes, (b) House Snake, (c) Blacksnake,	4	J. Couch, Hickory.
7190	Hop Toad,	8	J. Winegartner, Doylestown.
7207	Blowing Viper,	9	P. Oxford, N. Bangor.
7209	Common Water Snake,	9	F. S. Dickenshied, Zionsville.
7212	Rattlesnake,	9	H. Drill, Cogan House.
7213	(a) Painted Turtle, (b) Green Frog,	9	R. L. Jackson, McConnellsburg.
7217	Common Garter Snake,	10	F. S. Andrews, Wellsboro.
7223	Blowing Viper,	11	W. W. Climenson, Honeybrock.
7228	Copperhead,	11	R. V. Haas, Lykens.
7252	House Snake,	13	W. H. Grimm, Hamburg.
7253	House Snake,	13	R. L. Jackson McConnellsburg.
7254	House Snake,	13	G. A. Rinick, Chambersburg.
7276	Common Garter Snake,	15	S. Johnston, Coraopolis.

Specimens Received During August—Continued.

Number.	Specimen.	Date—August, 1906.	Name and Address.
7277	(a) 2 Common Garter Snakes, ... (b) Eggs of Ring-necked Snake), ...	16	D. H. Uncapher, Ebensburg.
7288	Blowing Viper, ...	17	J. G. Myers, Fayetteville.
7296	Copperhead, ...	17	J. F. Hufford, Amity.
7301	Copperhead, ...	17	J. J. Hardy, Mont Alto.
7307	Common Garter Snake, ...	18	W. E. Harley, Pottstown.
7312	Blowing Viper, ...	18	J. F. Harshberger, Strodes Mills.
7316	House Snake, ...	20	F. Branthaver, Chambersburg.
7317	Common Garter Snake, ...	20	H. F. Caterman, Irvona
7318	(a) Rattlesnake, ...	20	C. E. Denniston, Okome.
7328	Common Water Snake, ...	20	C. Bruckart, Lititz.
7332	(a) Common Swift (S. undulatus), .. (b) Newt (D. viridescens), ...	20	J. A. Shuey, Dauphin.
7334	Common Garter Snake, ...	20	J. F. Bradford, Lewistown.
7337	(a) Red Salamander (S. ruber), ... (b) Cave Salamander (S. long:-cauda).	21	H. B. Baker, Indiana.
7338	Newt, ...	21	D. C. Much, Dauphin.
7339	(a) 2 Brown Salamanders (D. fusca)	21	C. Kopp, York, New Salem P. O.
7342	Common Garter Snake, ...	21	G. J. Wimmer, Nazareth.
7349	Common Garter Snake, ...	21	T. A. Berkey, Easton.
7351	Copperhead, ...	22	M. L. Bloom, Kerrmoor.
7358	(a) 2 Rock Snakes, ... (b) Ribbon Snake, ... (c) Common Water Snake, ...	22	F. D. Keboch, Williamstown.
7364	Rattlesnake, ...	22	Rev. W. A. West, McConnellsburg.
7365	Copperhead, ...	22	——— ———, Barree.
7366	Common Garter Snake, ...	22	T. A. Berkey, Easton.
7367	Egg of Pilot Snake, ...	22	C. Anderson, Harrisburg.
7380	Pilot Snake, ...	23	E. Neale, Delmont.
7381	Eggs of Blacksnake, ...	23	J. W. Craig, Millerstown.
7397	Ribbon Snake, ...	24	S. P. Woodman, Rushland.
7399	Copperhead, ...	24	G. S. Reed, Baden.
7403	House Snake, ...	24	M. G. Marvin, Wellsboro.
7405	House Snake, ...	24	A. Cunningham, Newtown.
7418	Common Garter Snake, ...	25	W. H. Fischer, Coudersport.
7423	2 Common Garter Snakes, ...	27	G. M. Branthaver, Chambersburg.
7427	Grass Snake, ...	27	F. A. Keith, Eagle Foundry.
7431	(a) Common Garter Snake, ... (c) Brown Salamander, ... (d) Cave Salamander, ...	27	J. Couch, Hickory.
7439	Pilot Snake, ...	28	H. I Grove, Shirleysburg.
7443	House Snake, ...	28	W. A Spate, Loganville.
7455	Common Garter Snake, ...	28	H. J. Roddy, Jr., Millersville.
7456	Grass Snake, ...	28	P. S. Tooker, Easton.
7460	Copperhead, ...	28	H. H. Grant, Harrisburg.
7468	Eggs of Pilot Snake, ...	29	T. W. Beecher, Kerrsville.
7472	Common Garter Snake, ...	29	W. R. Bower Landisburg.
7476	Blacksnake, ...	29	Mrs. M. H. Hoffman, Carlisle.
7485	Common Garter Snake, ...	30	S. Johnston, Pittsburg.
7491	Copperhead, ...	30	I. C. Elder, Chambersburg.
7492	(a) Common Garter Snake, ... (b) Granite Salamander (P. glutinosus. (c) Striped Salamander (C. cinereus), (d) Meadow Frog (R. palustris), ... (e) Green Frog (R. clamitans), ...	30	C. L. Gruber, Kutztown.
7493	House Snake, ...	31	B. N. Spehrley, Pottsville.
7494	Blowing Viper, ...	31	State Hospital, Danville.
7496	House Snake, ...	31	F. D Mott Brookville.
7499	Newt, ...	31	C. Kopp, York, New Salem P. O.
7509	Common Box Tortoise, ...	31	C. Reed, Bridgeville.
7512	House Snake (T. carolina), ...	31	M. B. Irvin, Greencastle.
7513	(a) Blowing Viper, ... (b) Red Salamander, ...	31	M. C. Brightbill, Marsh Run.
	Birds and Mammals.		
7105	Weasel (P. noveboracensis), ...	1	E. E. C. Gibbs, Huntingdon.
7115	Baltimore Oriole, ...	2	Mrs. J. W. Atkinson Buckingham.
7134	Night Hawk, ...	3	R. W. Wehrle, Indiana.
7145	(d) Eggs of Chipping Sparrow, ...	4	J. Couch, Hickory.
7226	Yellow-billed Cuckoo, ...	13	W. S. Taylor, Harrisburg.
7243	Hoary Bat (L. cinereus), ...	13	G. Rupp and A. Hartwick, Harrisburg.
7287	Baltimore Oriole, ...	14	E. C. Gilbert, Bechtelsville.
7308	Skull of Grey Wolf, ...	17	J. A. Good, New Enterprise.
7304	Crow, ...	17	W. T. Williams, Pine Station.
7306	House Wren, ...	18	J. E. Suhrie, Crumb.
7312	Marsh Hawk, ...	18	M. R. Bower, Landisburg.
7321	Weasel (P. noveboracensis), ...	20	J. B. Lehman, Coudersport.

Specimens Received During August—Concluded.

Number.	Specimen.	Date—August, 1906.	Name and Address.
7350	Great Blue Heron,	22	S. M. Hess, Pine Grove.
7357	Great Blue Heron,	22	C. Anderson, Harrisburg.
7379	Hummingbird,	23	S. Baldy, Catawissa.
7382	Bald Eagle,	23	M. Tyler, Skinner's Eddy.
7422	Chimney Swift,	27	F. Britten, Harrisburg.
7431	(b) Jumping Mouse,	27	J. Couch, Hickory.
7463	(a) Crow,	29	W. H. Bullock, Honesdale.
7466	Head of Hawk,	29	J. A. Nissley, Mt. Joy.
7496	13-striped Spermophilus,	31	Mr. Sheck, Harrisburg.

Specimens Received During September, 1906.

Number.	Specimens—Insects.	Date—September, 1906.	Name and Address.
7515	(a) San José Scale, (b) Scurfy Scale,	1	D. J. Evans, Bangor.
7516	Roaches,	1	A. Baker, Gap.
7517	Saddle-back Larva,	1	F. M. Sanders, Fairfield.
7518	Scolytid Beetles,	1	R. D. Herr, Refton.
7524	(a) Saddle-back Larva, (b) Io Larva,	1	R. McCann, Harrisburg.
7525	Saddle-back Larva,	1	H. Falk, Harrisburg.
7526	Halisidota,	1	E. M. Mixer, Waterford.
7527	Slug Larva (P. pithecium),	1	H. F. Marsh, Wellsboro.
7529	Saddle-back Larva,	1	W. H. Barnes, Gettysburg.
7534	Regal Larva,	3	S. E. Waltman, Littlestown.
7535	Ichenumon (P. polyturator),	3	J. Morgan, Ridgway.
7536	Blister Beetles (E. pennsylvanica),	3	C. A. Sterner, Allentown.
7538	(a) Mole Crickets, (b) Cicada tibicen,	3	W. S. Glenn, Utica.
7539	Insects,	3	G. R. Ross, Lebanon.
7541	Bumble Flower Beetle (E. inda),	3	W. S. Irvine, Loysville.
7542	Oyster-shell Scale,	3	W. Goodban, Girard.
7543	(a) Halisidota Larva, (b) Grasshopper,	3	W. H. Bullock, Honesdale.
7544	Geometrid Larvæ,	3	Mrs. D. B. Shamway, Wellsboro.
7545	Oyster-shell Scale,	3	A. Lamb, Pleasantville.
7546	(a) Wooly Aphis,	3	J. D. Wentling, Greensburg.
7549	Cicada tibicen,	3	W. Codney, Wellsboro.
7550	San José Scale,	3	W. Keller, Pottsville.
7551	Insects,	3	Dr. O. T. Cruikshank, Swissvale.
7560	Insects,	4	S. Baldy, Catawissa.
7561	Regalis Larva,	4	W. A. Warner, Pineville.
7562	(a) Polyphemus Cocoon, (b) Saddle-back Larva,	4	Miss Anna K. Bewley, Forestgrove.
7563	Io Larva,	4	M. G. Marvin, Wellsboro.
7564	(a) Wooly Bear (D. virginica), (b) Tobacco Cutworm (H. rhexia),	4	J. S. Weaver, Kinzers.
7565	Oyster-shell Scale,	4	G. E. Cohen, Wilkes-Barre.
7566	Regalis Larvæ,	4	J. S. Rupp, Shiremanstown.
7567	Lecanium,	4	E. H. Cocklin, Bowmansdale.
7568	(a) San José Scale, (b) Oyster-shell Scale,	4	C. Reighard, Bedford.
7569	Rose Chafers,	4	T. C. Barlow, Fort Washington.
7570	Rose Sawfly Larva (C. americanum),	4	R. Nelson, McConnellsburg.
7578	Catalpa Sphinx,	4	S. Springer, Harrisburg.
7579	Imperial Moth,	4	N. W. Ream, Harrisburg.

Specimens Received During September—Continued.

Number.	Specimens—Insects.	Date—September, 1906.	Name and Address.
7581	Io Larva,	5	L. Moore, Brownsville.
7583	Regalis Larva,	5	H. B. Emerick, Lebanon.
7584	Collection of blown insect larvæ,	5	H. Hornig, Phila.
7585	Saddle-back Larva,	5	F. T. Chambers, Bristol.
7593	Wooly Aphis,	5	F. G. Fox, Erwinna.
7596	(a) Flannel Slug (L. crispata),	5	W. H. Salludo, Hereford.
7599	(b) Notodontid larva,		
	(a) Anthrenus larva,		
	(b) Sciara Larva (?),		
7600	San José Scale,	6	Emma B. Gill, Philipsburg.
7601	Bagworms,	6	J. J. Overdeer, Middletown.
7603	Oyster-shell Scale,	6	C. L. Brumbaugh, Wilkinsburg.
7604	Tussock Moth Larva,	6	J. W. Meier, Phoenixville.
7607	Five-spotted Sphinx,	6	C. Noel, Centennial.
7608	Slug Caterpilla (P. pithecium),	6	H. B. Surface, Camp Hill.
7609	(c) Pelecinus polyturator,	6	M. E. Baynes, Mansfield.
7611	Five-spotted Sphinx,	6	B. J. Powers, Corydon.
7613	Imperial Larva,	7	A. W. Steinruck, Middletown.
7614	Wooly Aphis,	7	W. B. Mehaffie, Duncannon.
7615	Aphid Galls,	7	J. S. Conrad, Lindsey.
7616	(a) Tussock Moth Larva,	7	V. Holslander, Columbia Cross Roads.
7617	San José Scale,	7	E. A. Wilcox, Sugar Run.
7618	(a) Io Larva,	7	B. B. Goodling, Loganville.
	(b) Sphinx Larva (A. myron),		
7620	Oyster-shell Scale,	7	M. G. Marvin, Wellsboro.
7623	(a) Regalis Larva,	7	M. Ewing, Manorhill.
	(b) Sphinx Larva (P. excæcatus),		
7624	Maple pseudococcus,	7	J. R. Gilmore, Chambersburg.
7625	Joint Worms,	7	T. Sexton, Bellefonte.
7626	San José Scale,	7	C. W. McClellan, Edinburg.
7627	Oyster-shell Scale,	7	R. E. Rogers, Danville.
7628	Jassids,	7	E. A. Kuhns, Pinegrove.
7629	Oyster-shell Scale,	7	F. F. Garber, Harrisburg.
7630	Insects,	7	J. O. Anderson, Sugargrove.
7631	(a) San José Scale,	7	A. M. Yingling, Altoona.
7632	Io Larva,	7	G. W. Shunk, Harrisburg.
7633	Phobetron pithecium,	7	G. Rupp, Harrisburg.
7634	Regalis Larva,	8	M. F. Doyle, McConnellsburg.
7635	Lachnosterna grubs,	8	L. M. Piper, Carlisle.
7636	Wooly Aphis,	8	Frank Battles, Newton Square.
7637	Five-spotted Sphinx,	8	J. W. Craig, Millerstown.
7638	Oyster-shell Scale,	8	E. S. Mills, New Castle
7643	(b) Aphids,	8	W. H. Schuckers, Reynoldsville.
7645	Regalis Larva,	8	E. M. Stover, Hatfield.
7646	Lecanium,	8	H. Schick, Harrisburg.
7651	Robber Fly (Erax maculatus),	10	J. L. Plummer, Hollidaysburg.
7653	Io Larva,	10	W. T. Crawford, Hineston, Louisiana.
7654	(b) Regalis Larva,	10	R. T. Clippinger, Mowersville.
7655	Regalis Larva,	10	W. H. Zinn, Dauphin.
7656	Regalis Larva,	10	M. E. Haner, Bendersville.
7658	Locust Borer,	10	G. Stoya, Jr., Reynolds.
7659	Peach Borer,	10	H. E. Smith, Parkesburg.
7661	Oyster-shell Scale,	10	R. J. Kise, Stroudsburg.
7662	San José Scale,	10	D. Card, Emporium.
7663	Pipe-vine Swallow-tailed Larva,	10	J. F. Werner, York.
7667	(b) Oyster-shell Scale,	10	E. C. Tyson, Bendersville.
7671	Cicada tibicen,	11	J. A. Shupp, Gilbert.
7676	(b) Cecidomyia Larvæ,	11	R. W. Wehrle, Indiana.
7678	(a) Round-head Apple Tree Borer (S. candida),	11	Mrs. M. M. Hildebrant, Mt. Joy.
	(b) Ribbed Bucculatrix Cocoon,		
7679	Mole Cricket,	11	B. M. Stone, Stull.
7681	Katydid Eggs	11	H. Kerstetter, Liverpool.
7682	(a) San José Scale,	11	J. G. Kreider, Mt. Joy.
	(b) Scurfy Scale,		
7684	Yellow Swallowtail,	11	Rev. Wm. P. Davis, National Park, N. J.
7685	Insects,	11	A. Black, Maplewood.
7686	San José Scale,	11	E. P. Shook, Spring Mills.
7693	(a) Scurfy Scale,	11	J. F. Mayer, Johnstown.
	(c) Codling Moth,		
	(e) Work of Plum Curculio,		
7695	Flat-headed Borer Larvæ,	12	S. J. Allis, Erie.
7696	Thalessa lunator,	12	R. J. Kise, Stroudsburg.
7697	Mole Cricket,	12	R. R. Simcox, Jersey Shore.
7699	(b) Butterfly (Papilio troilus),	12	F. Anderson, Geneva.
7701	Katydid (M. retinerve),	12	M. C. Brightbill, Marsh Run.
7702	Bumble Flower Beetle (E. inda),	12	G. Barnes, Harrisburg.
		12	L. B. Huff, Greensburg.

Specimens Received During September—Continued.

Number.	Specimens—Insects.	Date—September, 1906.	Name and Address.
7704	(a) Digger Wasp,	12	J. A. Jefferson, Vail, N. J.
7705	Imperial Larva,	12	G. B. Daniels, McConnellsburg.
7707	(a) Hellgamite,		
	(b) H. caryae larva,	13	Mrs. J. A. Williams, Sayre.
7709	(a) Shot-hole Borers,		
	(b) Rove Beetle,	13	W. H. Koller, Allen.
7710	Roach (P. americana),	13	W. H. Brinkerhoff, Lees Cross Roads.
7721	Gold Bug (C. auricha1cea),	13	E. J. Hartline, Spangsville.
7732	(a) Io Larva,		
	(b) Sphinx Larva (S. chersis),	14	D. M. Hollinger, Wayesboro.
7733	Aphid (Lachnus sp.),	14	V. Angerer, Ridley Park.
7738	(a) Lecanium,		
	(b) Moth Larvæ,		
	(c) Ants,	14	Dr. A. F. Shively, Phila.
	(d) Aleurode,		
7741	(a) Lepidoptera Larva,		
	(b) Polyphemus Larva,	14	Mrs. C. J. Barney, Warren.
7742	Dogday Cicada,	14	C. R. Foble, Alexandria.
7752	(a) Lady Beetle Larvæ,		
	(b) Cucumber Plant Lice,	15	J. M. Tripp, Waverly.
	(c) Syrphid Fly Larva,		
7753	Insects,	15	Mrs. G. P. West, Danville.
7756	Leaf Rolling Moth Larvæ,	15	R. C. Bancroft, Toughkenamon.
7758	Imperialis Larva,	15	Mrs. L. F. Shoemaker, Lansdowne.
7759	(a) Polyphemus Larva,		
	(b) Io Larva,	15	R. Nelson, McConnellsburg.
	(c) Silver Fish (L. saccharina),		
7760	Crane Fly (Bittacomorpha sp.),	15	W. Landis, Phila.
7762	Tussock Moth,	15	W. Chapman, Claysville.
7763	Regalis Larva,	15	H. S. Byerts, Shippensburg.
7764	(a) San José Scale,		
	(b) Scurfy Scale,	17	Rev. A. T. G. Apple, Bedford.
7768	Insects,	17	R. D. Spencer, Williamsport.
7770	Wooly Aphis,	17	C. A. Reichle, York.
7772	Insects,	17	J. C. Smith, New Albany.
7773	Maple Pseudococcus,	17	R. J. Kise, Stroudsburg.
7774	(a) Scurfy Scale,	17	Hon. N. B. Critchfield, Johnstown.
7775	Katydid Eggs,	17	F. Black, Wormleysburg.
7777	Water Beetle (H. triangulus),	17	Mrs. A. Weidman, Norristown.
7780	Larvæ of Sphinx chersis,	17	J. T. Bollinger, Doublin Mills.
7781	Cocoons of Slug (P. scapha),	17	J. A. Clark, Berwyn.
7782	Darkling Beetle,	17	I. C. Williams, Harrisburg.
7787	(a) Leopard Moth Larva (P. deflorata),		
	(b) Larva of Sphinx (P. pandorus),	18	L. E. Satterthwait, Westtown.
7790	(a) Io Larvæ,		
	(b) Arctiid Larva,	18	M. R. Bowers, Landisburg.
7791	Flannel Slug (L. crispata),	18	E. F. Brent, Manchester.
7792	(a) Work of Curculio,		
	(b) Work of Codling Moth,	17	W. K. Warden, Oxford.
	(c) San José Scale,		
7793	(a) Saddle-back Larva,		
	(b) Milk Weed Moth,	18	H. P. Smith, Buckmansville.
7794	(a) Plant Lice,		
	(b) Ants,	18	J. S. Harder, Clearfield.
	(c) Stalk Eggs of Chrysopa,		
7795	San José Scale,	18	J. M. Ironefield, Wayne.
7799	Mole Cricket,	18	J. D. Harbinson, Saxonburg.
7801	Work of Melon Plant Lice,	18	M. S. Davis, Clark's Green.
7802	Dragon Fly,	18	H. B. Eberly, Shiremanstown.
7803	Larva of P. excaecatus,	18	W. Codney, Wellsboro.
7804	Maple pseudococcus,	18	F. Transue, Stroudsburg.
7805	(a) Scurfy Scale,		
	(b) Apple Aphis,	18	G. F. Miller, New Kingstown.
7812	(b) Beetle,	19	J. B. Glover, Collingdale.
7813	Cells of a Bee (Megachile sp.),	19	W. J. Smith, Schuyler.
7814	Rose Scale,	19	H. Schick, Harrisburg.
7815	San José Scale,	19	Miss H. Harris, Aldan.
7818	Chrysalis of Milkweed Butterfly (D. plexippus),	19	M. F. Doyle, McConnellsburg.
7819	Chrysalis of Milkweed Butterfly (D. plexippus),	19	J. S. Shaffer, Codorus.
7822	Larva of White-lined Morning Sphinx,	20	D. W. Navle, Wellsboro.
7825	(a) Lecanium,		
	(b) Lecanium-feeding Moth Larva,	20	Dr. A. F. Shively, Phila.
	(c) Ant,		

Specimens Received During September—Continued.

Number.	Specimen.	Date—September, 1906.	Name and Address.
7832	(a) Lecanium,	20	J. K. Snively, Chambersburg.
	(b) Scurfy Scale,	20	G. R. Prichard, Harrisburg.
7836	Saddle-back Larva,	21	H. R. Snyder, Berwick.
7837	Flea,		
7838	(a) Grain Weevil (C. granaria),		
	(b) Meal Beetle (Silvanus surinamensis),	21	J. H. Miller, Topton.
	(c) Chalcid Parasites,		
7841	Wheat-joint Worm,	21	J. J. Oligher, Indiana.
7842	Mole Cricket,	21	N. H. Elder, Turnip Hole.
7851	(a) Oval-winged Katydid,		
	(b) Cicada tibicen,	21	L. E. Satterthwait, Westtown.
7852	(a) Saddle-back Larva,		
	(b) Parasitized Sphinx Larva,	22	F. H. Brinton, W. Chester.
	(c) Braconid Parasites of Sphinx,		
7859	Imperlias Larva,	22	Dr. B. A. Hoover, Wrightsville.
7862	(f) Polyphemus Larva,		
	(g) Parasites of Polyphemus Larva,	24	E. M. Mixer, Waterford.
7863	(a) Fungus Beetle (T. infumata),		
	(b) Beetle (Latridius minutus),	24	Waterford Farming Co., Waterford.
	(d) Psocid,		
7865	Insects Affecting Wheat,	24	J. H. Miller, Topton.
7867	(a) San José Scale,		
	(b) Scurfy Scale,	24	H. T. Hartman, Fairfield.
7869	Insects,	24	E. P. Shook, Spring Mills.
7871	Cecropia Cocoon,	24	L. Hardy, Wellsboro.
7878	(a) Milkweed Butterfly,		
	(b) Six-Spotted Tiger Beetle,	25	J. F. Dymond, Uniontown.
7890	(a) Milkweed Butterfly,		
	(b) Red-necked Datana,	25	W. H. Bullock, Honesdale.
	(c) Locustidæ,		
7881	Chestnut Weevil,	25	N. H. Elder, Turnip Hole.
7883	Cellery Worm (P. polyxenes),	25	L. E. Satterthwait, Westtown.
7896	Polyphemus Larva,	25	Dr. I. M. Wells, Harrisburg.
7898	Fungus Beetle (T. infumata),	25	J. Good, Wapwallopen.
7907	(a) Scurfy Scale,	26	A. E. Fretts, Greensburg.
7908	(a) Scurfy Scale,		
	(b) San José Scale,	26	E. Wells, Wilkes-Barre.
7909	Oyster-shell Scale,	26	E. E. May, Mans Choice.
7916	Oyster-shell Scale,	27	J. M. Kennedy, Alden Sta.
7917	Milkweed Butterfly,	27	M. Snyder, Newville.
7918	(b) Carabid Beetle,	27	W. H. Bullock, Honesdale.
7920	Oyster-shell Scale,	27	C. G. Brown, Huntingdon.
7926	(a) Scurfy Scale,	28	A. A. Burkett, Klahr.
7928	Promethea Cocoon,	28	Dr. D. W. Bortz, Esterly.
7930	Lecanium,	28	F. Moore, Williamsport.
7935	Moth Larvæ,	29	P. C. Angelmyer, Gilbert.
	Invertebrates Not Insects.		
7515	(c) Mites,	1	D. J. Evans, Bangor.
7546	(b) Mites,	3	J. D. Wentling, Greensburg.
7551	(p) Crayfish,	3	Dr. O. T. Cruikshank, Swissvale.
7616	(b) Spiders,	7	E. A. Wilcox, Sugar Run.
7621	Centipedes,	7	S. N. Warfel, Strausburg.
7631	(b) Mites,	7	G. W. Shunk, Harrisburg.
7660	Millipedes,	10	J. A. Shuey, Penbrook.
7698	(b) Red Mites,	12	S. J. Allis, Erie.
7703	(b) Garden Spider,	12	D. C. Urich, Penbrook.
7704	(b) Lycosid Spider,	12	J. A. Jefferson Vail, N. J.
7714	Garden Spider,	13	C. B. Steele, S. Plainfield, N. J.
7734	Spider,	14	A. Caprio, Lock Haven.
7764	(c) Red Spiders,	17	Rev A. T. G. Apple, Bedford.
7772	(f) Mite from Bee,	17	J. C. Smith, New Albany.
7811	Mites,	19	W. J. Hallowell, Hallowell.
7813	(c) Millipedes,	19	J. B. Glover, Collingdale.
7817	Garden Spider,	19	E. H. Hartline, Spangsville.
7831	Gordius (?),	20	G. A. Behney, Ellwood.
7862	(b) Mussel Shell (Unio undulatus,		
	(c) Mussel Shell (Unio purpureus),		
	(d) Mussel Shell (Unio triangulus),	24	E. M. Mixer, Waterford.
	(e) Mussel Shell (Unio luteus),		
7869	(l) Spider Egg Mass,	24	E. P. Shook, Spring Mills.
7906	(d) Spider,	26	M. Couch, Hickory.
7907	(b) Red Mites,	26	A. E. Fretts, Greensburg.
7926	(b) Red Mites,	28	A. A. Burkett, Klahr.

Specimens Received During September—Continued.

Number.	Specimen.	Date—September, 1906.	Name and Address.
	Fishes, Batrachians and Reptiles.		
7519	Water Snake (N. sipedon),	1	W. B. Croasdale, Chinchilla.
7520	Pilot Snake (C. obsoletus),	1	L. I. Seaman, Wilmore.
7521	Copperhead (A. contortrix),	1	Dr. R. A. Stewart, Independence.
7522	House Snake (L. d. triangulus),	1	G. M. Brinton, Irwin.
7528	Pilot Snake,	3	D. W. Beecher, Kerrsville.
7530	Rattlesnake (C. horridus),	3	L. I. Seaman, Wilmore.
7531	(a) Common Garter Snake (T. sirtalis),	3	H. E. Cress, Jumonville.
	(b) Copperhead Snake,		
7532	(2) Copperhead Snakes,	3	H. G. Fuckenberg, Indiana.
7540	Rattle Snake,	3	T. Oxford, Jr., Bangor.
7551	(a) House Snake,	3	Dr. O. T. Cruikshank, Swissvale.
	(b) (3) Garter Snakes,		
	(c) Brown Salamanders (D. fusca),		
	(d) Cave Salamander (S. longicauda),		
	(e) Spotted Salamander (A. punctatum),		
	(f) Granite Salamander (P. glutinosus),		
	(g) Striped Salamander (P. cinereus),		
	(h) Queen Snake (R. liberis),		
	(i) Purple Salamander (G. porphyriticus),		
	(j) Wood Frog (R. sylvatica),		
	(n) Eggs and young of batrachians,		
	(o) Fishes,		
	(q) Green Frog (R. clamitans),		
	(r) Hoptoad (B. l. americana),		
	(s) Newt (D. viridescens),		
7552	Rattle Snake,	4	B. J. Powers, Corydon.
7553	(a) House Snake,	4	J. Good, Wapwallopen.
	(b) (2) Green Frogs,		
	(c) Wood Tortoise (C. insculptus),		
7554	Common Garter Snake,	4	W. A. Bangs, Millville.
7555	Rattle Snake,	4	J. Snyder, Newton Hamilton.
7556	(a) House Snake,	4	J. D. Baker, Philipsburg.
	(b) Spotted Salamander,		
7557	House Snake,	4	G. M. Brenner, Hayes Grove.
7558	Rattle Snake,	4	J. C. Williams, Emporium.
7559	Pilot Snake,	4	L. Blum, Kerrmoor.
7576	Box Tortoise (T. carolina),	4	M. M. Naginey, Milroy.
7583	Water Snake,	5	Mrs. G. R. Julius, Littlestown.
7586	Water Snake,	5	N. J. Kocher, Danville.
7587	(a) Granite Salamander,	5	Anna M. Goss, Port Matilda.
	(b) Ring-necked Snake (D. punctatus),		
7588	Black Snake (B. constrictor),	5	J. Crozier, Williamstown.
7589	(a) Common Garter Snake,	5	G. Parnell, Williamstown.
	(b) Green Frog,		
	(c) Varied Tree Frog (H. versicolor),		
7591	Copperhead,	5	R. E. Steckley, Newport.
7592	(a) Hog-nosed Viper (H. platyrhinos),	5	A. B. Lehman, Fayetteville.
	(b) Wood Tortoise,		
	(c) Box Tortoise,		
7596	Grass Snake (L. vernalis),	6	W. J. Keller, Pottsville.
7597	Rattle Snake,	6	D. H. Uncapher, Ebensburg.
7598	Rattle Snake,	6	S. Rager, Vintondale.
7606	Box Tortoise,	6	J. D. Weber, Westpoint.
7609	(a) Common Garter Snake,	6	B. J. Powers, Corydon.
	(b) Newt,		
7610	Rattle Snake,	6	E. R. Mulford, Wellsboro.
7622	Blowing Viper,	7	N. P. Martin, Upton.
7630	(a) (3) Grass Snakes,	7	A. M. Yingling, Altoona.
	(b) Red-bellied Snake (S. occipitomaculata),		
7639	Black Snake,	8	H. F. Seaman, Wilmore.
7641	Rattle Snake,	8	A. P. White, Lock Haven.
7643	(a) Varied Tree Frog,	8	E. M. Stover, Hatfield.
7644	Ring-necked Snake,	8	B. P. Hooke, Landisburg.
7649	Common Garter Snake,	10	K. P. Allshouse, Brookville.
7650	Common Garter Snake,	10	J. Q. Johnson, Woodbine.
7654	(a) Swift (S. undulatus),	10	W. H. Zinn, Dauphin.

Specimens Received During September—Continued.

Number.	Specimen.	Date—September, 1906.	Name and Address.
7666	(2) Rattle Snakes,	10	F. A. Godcharles and A. M. Wilson, Lock Haven.
7667	(a) Garter Snake,	11	J. A. Shupp, Gilbert.
7668	Eggs of Black Snake,	11	W. H. Harpster, Charter Oak.
7669	(a) Blowing Viper,		
	(b) Copperhead,	11	A. R. Bittinger, Fayetteville.
7670	Copperhead,	11	D. V. Ferguson, Lumber City.
7672	Grass Snake,	11	C. C. Curtis, Jr., Williamstown.
7673	Blowing Viper,	11	J. H. Mark, Wiconisco.
7674	Box Tortoise,	11	L. C. Carl, Williamstown.
7680	House Snake,	11	Dr. H. H. Bordner, Shamokin Dam.
7689	Copperhead,	12	H. C. Yuckenberg, Indiana.
7690	(a) (2) Box Tortoises,		
	(b) Bull Frog (R. catesbiana),	12	S. S. Kane, Landisburg.
	(c) Water Snake,		
7691	Pilot Snake,	12	D. Andrews, Inglenook.
7692	Garter Snake,	12	J. A. Shupp, Gilbert.
7694	(a) (2) Water Snakes,		
	(b) Cricket Frog (A. gryllus),	12	M. M. Brunner, Iron Bridge.
7698	Ring-necked Snake,	12	A. Drysdoll, Canton.
7699	(a) House Snake,	12	M. C. Brightbill, Marsh Run.
7700	House Snake,	12	Miss R. Williams, Royersford.
7706	Blowing Viper,	13	J. M. Geddes, Williamsport.
7711	Bull Frog,	13	H. Farnell, Williamstown.
7712	Box Tortoise,	13	M. M. Brunner, Iron Bridge.
7713	Garter Snake,	13	Miss C. B. Steele, S. Plainfield, N. J.
7715	Ring-necked Snake,	13	Dr. F. S. Castlebury, Roaring Branch.
7716	(a) Garter Snake,		
	(b) House Snake,	13	E. M. Mixer, Waterford.
7717	Black Snake,	13	W. C. Leedy, Upper Strasburg.
7719	Black Snake,	13	J. L. Enyeart, Shirleysburg.
7722	(2) Pilot Snakes,	13	W. H. Zinn, Dauphin.
7723	Red Salamander (S. ruber),	13	R. Naugle, Dauphin.
7726	(a) Copperhead,		
	(b) Box Tortoise,	13	H. L. Stoner, Mifflintown.
7727	Snapping Turtle (C. serpentina),	14	R. W. Wehrle, Indiana.
7728	Garter Snake,	14	E. S. Seaman, Wilmore.
7729	Blowing Viper,	14	W. M. Beekley, Phila.
7730	(b) Garter Snake,	14	A. A. Spencer, Wellsboro.
7731	(a) Purple Salamander,		
	(b) Brown Salamander,	14	A. F. Seaman, Wilmore.
7736	(a) Garter Snake,		
	(b) Green Frog,	14	M. M. Brunner, Iron Bridge.
7737	(a) Garter Snake,		
	(b) Meadow Frog (R. palustris),	14	W. M. Brunner, Krumsville.
7740	Granite Salamander,	14	A. B. Moore, Reynoldsville.
7743	Garter Snake,	14	G. W. Whitehall, Etters.
7744	Brown Salamander,	15	J. Jones, Williamstown.
7745	Red Salamander,	15	F. Curtis, Williamstown.
7746	Blowing Viper,	15	G. Good, Williamstown.
7747	Ribbon Snake (T. sauritus),	15	J. Morris, Williamstown.
7748	Garter Snake,	15	J. Ferron, Williamstown.
7750	Blowing Vipers,	15	J. A. Souder, Mont Alto.
7754	Garter Snake,	15	W. T. Fitzpatrick, Middletown.
7757	Water Snake,	15	M. M. Brunner, Iron Bridge.
7765	Water Snake,	17	A. Clauser, Williamstown.
7766	Garter Snake,	17	W. Ramsey, Williamstown.
7772	(a) Garter Snake,	17	J. C. Smith, New Albany.
7778	Garter Snake,	17	L. S. Peiffer, Fredericksburg.
7783	(a) (5) Painted Turtles (C. picta),		
	(b) Musk Turtle (A. odoratus),	17	G. C. Roberts, Sharon Hill.
7785	Copperhead,	18	L. Bloom, Kerrmoor.
7786	(a) Red-bellied Snake,		
	(b) Garter Snake,	18	E. M. Mixer, Waterford.
7788	Garter Snake,	18	W. H. Bullock, Honesdale.
7796	Garter Snake,	18	Mrs. J. W. Atkinson, Buckingham.
7798	Garter Snake,	18	Boyertown High School, Boyertown.
7806	(a) (3) Bull Frogs,		
	(b) Meadow Frog,	19	R. I. Myers, Welty.
7807	(2) Mud Turtles,	19	H. Harker, Westtown.
7808	Grass Snake,	19	A. B. Winchester, McElhattan.
7809	Pilot Snake,	19	H. B. Eberly, Shiremanstown.
7820	(a) (2) Meadow Frogs,	20	W. H. Bullock, Honesdale.
7822	Garter Snake,	20	F. M. Van Schaack, Harrisburg.
7827	(a) (3) Water Snakes,		
	(b) House Snake,		
	(c) Rattle Snake,	20	B. P. Rothrock, Williamsport.
	(d) Painted Turtle,		

Specimens Received During September—Continued.

Number.	Specimen.	Date—September, 1906.	Name and Address.
7828	Garter Snake,	20	C. Pfleegar, Williamsport.
7829	Water Snake,	20	F. E. Galbraith, Williamsport.
7830	Rock Snake (S. dekayi),	20	C. Van Housen, Williamsport.
7834	Black Snake,	20	H. H. Attig, Paxtonville.
7845	House Snake,	21	P. H. Keboch, Berrysburg.
7846	Bull Frog,	21	I. Keboch, Berrysburg.
7847	Purple Salamander,	21	E. Host, Williamstown.
7848	Newt,	21	E. Tooey, Williamstown.
7849	Red Salamander,	21	G. Baddorf, Williamstown.
7850	(a) Painted Turtle, (b) (2) Bull Frogs, (c) (7) Green Frogs, (d) (2) Meadow Frogs,	21	Boyertown High School, Boyertown.
7854	(a) Red Salamander, (b) Purple Salamander,	22	R. W. Wehrle, Indiana.
7855	House Snake,	22	A. T. Lilley, Leroy.
7856	(a) Box Tortoises,	22	M. R. Good, Narvon.
7858	Box Tortoise,	22	M. M. Brunner, Iron Bridge.
7860	Pilot Snake,	24	O. N. Shaffer, Hyndman.
7861	Pilot Snake,	24	J. H. Wilson, Huntingdon.
7862	(a) Red-bellied Snake,	24	E. M. Mixer, Waterford.
7864	Water Snake,	24	A. F. Dallaplaine, Ringtown.
7870	Garter Snake,	24	M. E. Baynes, Mansfield.
7872	House Snake,	24	C. A. Reichle, York.
7873	Blowing Viper,	24	E. P. Shook, Spring Mills.
7875	Blowing Viper,	24	R. F. Warren, Lurgan.
7876	Grass Snake,	24	H. H. Attig, Paxtonville.
7877	Garter Snake,	24	W. W. Climenson, Honey Brook.
7879	Wood Frog,	25	G. W. Seaman, Wilmore.
7882	Blowing Viper,	25	I. H. Kinney, Portland.
7884	Newt,	25	F. D. Keboch, Williamstown.
7886	House Snake,	25	E. Fisher, Harrisburg.
7888	Brown Salamander,	25	H. Kirchoff, Williamstown.
7889	Red Salamander,	25	H. Kirchoff, Williamstown.
7890	Brown Salamander,	25	L. F. Rubendale, Williamstown.
7891	Brown Salamander,	25	M. Deibler, Berrysburg.
7892	Box Tortoise,	25	D. Good, Williamstown.
7893	Blowing Viper,	25	W. Good, Williamstown.
7894	House Snake,	25	S. Baddorf, Williamstown.
7897	House Snake,	25	H. M. McKinstry, Chalfonte.
7900	Water Snake,	26	G. C. Maul, Gum Tree.
7901	Box Tortoise,	26	O. S. Gettschalk, Iron Bridge.
7902	(a) Water Snake, (b) Rock Snake,	26	E. M. Mixer, Waterford.
7903	Water Snake,	26	O. N. Shaffer, Hyndman.
7905	Pilot Snake,	26	E. Wheeler, Harrisburg.
7906	(a) (2) Queen Snakes, (b) Box Tortoise, (c) Leopard Frog (R. pipiens),	26	M. Couch, Hickory.
7910	Box Tortoise,	26	C. Adams, Williamstown.
7911	Box tortoise,	26	W. Drum, Williamstown.
7912	Box tortoise,	26	H. Wiest, Williamstown.
7913	Pilot Snake,	27	R. E. Rogers, Sugar Creek.
7914	Pilot Snake,	27	Dr. C. Kling, New Straitsville.
7915	(a) (2) Ring-necked Snakes, (b) Copperhead, (c) (11) Striped Salamanders, (d) Granite Salamander, (e) (8) Two-striped Salamanders (S. bilineatus), (f) (5) Brown Salamanders,	27	J. J. Hardy, Columbia.
7918	(a) Striped Salamander,	27	W. H. Bullock, Honesdale.
7923	(a) Spreckled Trout (C. guttatus), (b) Box Tortoise, (c) Bull Frog, (d) Green Frog, (e) House Snake,	28	Boyertown High School, Boyertown.
7924	Garter Snake,	28	H. H. Attig, Paxtonville.
7927	(b) Green Frog,	28	W. H. Bullock, Honesdale.
7931	Box Tortoise,	28	S. A. Brunner, Krumsville.
7932	(a) Rattle Snake, (b) House Snake,	29	J. C. Williams, Mountaindale.
7933	(a) Queen Snake, (b) Green Frog, (c) (2) Brown Salamanders,	29	R. W. Wehrle, Indiana.
7934	Copperhead,	29	Miss Sober, Dauphin.

Specimens Received During September—Concluded.

Number.	Specimen.	Date—September, 1906.	Name and Address.
	Birds and Mammals.		
7551	(t) Common Mole (S. aquitacus),.. (u) Shrew (B. brevicauda), ...	3	Dr. O. T. Cruikshank, Swissvale.
7619	Night Hawk, ...	7	S. W. Gilbert, Waterford.
7642	Flying Squirrel, ...	8	R. A. Kindt, Walnutport.
7647	Kangaroo Mouse, ...	10	M. DeT. High, Oley.
7730	(a) Blue Jay, ...	14	A. A. Spencer, Wellsboro.
7749	Wilson's Thrush, ...	15	F. A. Shaw, Wellsboro.
7927	(a) Blue Jay, ...	28	W. H. Bullock, Honesdale.

Specimens Received During October, 1906.

Number.	Specimens—Insects.	Date—October, 1906.	Name and Address.
7938	(a) Papilio polyxenes Jupæ, ... (b) Io Larva, ... (c) Polyphemus Cocoon, ...	1	Miss Dessie Hollinger, Waynesboro.
7939	(a) Scurfy Scale, ...	1	W. O. Lentz, Mauch Chunk.
7944	San José Scale, ...	1	D. C. Bryant, Torrey.
7945	(a) Robber Fly, ... (b) Cricket (N. fasciatus), ... (c) Snowy Tree Cricket (O. niveus),	1	W. L. Jacobs, Waynesburg.
7952	Bag Worm Cocoons, ...	2	Mrs. J. W. Atkinson, Buckingham.
7953	Milkweed Butterfly Chrysalis, ...	2	G. Bedford, Nazareth.
7955	Work of Aphids, ...	2	I. Chapin. Shickshinny.
7956	Imperalis Larvæ, ...	2	H. Jackson, Harrisburg.
7959	Grouse Locust (C. lateralis), ...	2	H. S. Pennington, Harrisburg.
7962	(b) Dragon Fly, ...	2	Mrs. E. Schermerhorn, Elgin.
7964	San José Scale, ...	2	S. R. Miller, Altoona.
7965	(a) Louse Fly from Great-horned Owl, ...	2	M. R. Bower, Landisburg.
7968	Burying Beetle (N. tomentosus), ...	3	Dr. I. M. Wells, Harrisburg.
7969	Walking Stick, ...	3	R. Seal, Harrisburg.
7973	San José Scale, ...	3	D. P. Landis, Altoona.
7975	Aphids, ...	3	L. B. Small, Marion.
7977	Insects, ...	2	W. J. Hallowell, Hallowell.
7983	Cynip Galls, ...	5	F. C. Knapp, Berwyn.
7989	Collection of Mounted Insects (about fifty species), ...	6	T. H. Hood, Chicago, Ill.
7998	(a) Moth Cocoon, ... (b) Butterfly Chrysalis, ...	8	J. D. Storm, Ariel.
8014	(a) San José Scale, ...	9	G. L. McCabe, Waverly, N. J.
8015	(a) Larva of Tobacco Pod Cutworm, (b) Work of the same, ...	9	J. S. Weaver, Kinzers.
8016	Muscid Flies, ...	9	F. R. Masters, New York City, N. Y.
8019	(a) Red-humped Apple Worm, ... (b) Ribbed Bucculatrix Cocoons,.... (c) Oyster-shell Scale, ...	10	W. H. VanFleet, Factoryville.
8020	(a) Oyster-shell Scale, ...	10	E. D. Goodwin, Titusville.
8025	Promothea Cocoon, ...	10	H. Schick, Harrisburg.
8035	(a) Scurfy Scale, ... (b) Oyster-shell Scale, ...	10	U. M. Boyd, Hookstown.
8036	Mounted Specimens of (a) Morning Cloak Butterfly Larvæ, (b) Fall Canker Worm on food plant (c) Female Canker Worm depositing eggs, ...	11	R. Dickson, Pittsburg.

Specimens Received During October—Continued.

Number.	Specimens—Insects.	Date—October, 1906.	Name and Address.
8037	Underwing Moth,	11	C. Anderson, Harrisburg.
8038	Crane Fly,	11	C. Anderson, Harrisburg.
8045	(a) San José Scale,		
	(b) Scurfy Scale,	12	A. H. Shank, Dillsburg.
8048	(a) San José Scale,		
	(b) Scurfy Scale,		
8058	Insects,	13	F. T. Moore, Williamsport.
8062	Oyster-shell Scale,	15	J. G. Reist, Pequa Station.
8063	(a) Work of Bark Beetles,	15	Miss M. A. Moffet, Glenn Summit Springs.
8071	(a) Louse from Coot,	15	J. M. Colton, Jenkintown.
8072	Insects,	16	C. H. Yuchenberg, Indiana.
8080	(c) Pupa of White-line Sphinx,	16	R. W. Wehrle, Indiana.
8083	(b) Common Sulphur-wing Butterfly,	16	U. E. Smith, Monroetown.
8085	(a) San José Scale,		J. R. Derr, Arters.
	(b) Scurfy Scale,	16	L. L. Beisel, Wilkes-Barre.
	(d) Tussock Moth Cocoon,		
8089	White-lined Morning Sphinx Larva,	17	Mrs. S. M. Smith, Penbrook.
8098	San José Scale,	17	M. H. Musser, Lancaster.
8106	Gold Beetle (C. signifera),	18	R. W. Wehrle, Indiana.
8010	(b) Pupa of Tomato Sphinx,	18	D. C. Urich, Penbrook.
8113	Mole Cricket,	19	F. A. Shaw, Albion.
8113	Flies (Sarsophaga sp.),	19	F. R. Masters, New York City, N. Y.
8114	(a) Tree-cricket Egg Punctures,	19	William Claar, Queen.
8116	Insects,	19	E. L. Johnson, Evans, Col.
8124	(a) San José Scale,	22	J. Neal, Phila.
8126	Regalis Moth Pupa,	22	J. S. Farver, Elizabethtown.
8136	Chestnut Insects,	23	W. J. Hallowell, Hallowell.
8140	(a) Scurfy Scale,		
	(b) Oyster-shell Scale,	24	T. P. Meyer, Lock Haven.
8145	Catalpa Sphinx Larva,	25	Miss L. Sheetz, Harrisburg.
8146	Angoumois Grain Moth,	25	Gov. Samuel Pennypacker, Schwenksville.
8149	(a) Cynthia Cocoons,		
	(b) Cecropia Cocoons,	25	F. B. Stutsman, Brooklyn, N. Y.
	(c) Parasitic Wasp (Ophion sp.),		
8204	(a) Aphids,		
	(c) Oyster-shell Scale,	30	A. H. Air, Scranton.
8209	Rose Scale,	30	R. E. Stauffer, Mechanicsburg.
8210	Green-house Scale (C. aonidum),	30	Mrs. W. R. Fehring, Harrisburg.
	Invertebrates Not Insects.		
7939	(b) Mites,	1	W. O. Lentz, Mauch Chunk.
7954	Snail (Pupa sp.),	2	C. T. Harbaugh, Sewickley.
7980	Garden Spider,	5	Captain J. H. Johnson, Smith's Ferry.
8001	Garden Spider,	8	Geo. Border, Harrisburg.
8009	Slug,	9	F. Van Schaack, Harrisburg.
8020	(b) Red Mites,	10	E. D. Goodwin, Titusville.
8055	Centipedes,	15	T. K. Jones, Harrisburg.
8072	(f) Snails,	16	R. W. Wehrle, Indiana.
8085	(c) Red Mites,	16	L. L. Beisel, Wilkes-Barre.
8097	Spider,	17	C. Fullwood, Wellsboro.
8124	(b) Mites,	22	J. Neal, Phila.
8127	Garden Spider,	22	C. N. Greene, Troy.
8138	Garden Spider,	24	W. G. Murtorff, Benore.
8139	Garden Spider,	24	W. Troup, Harrisburg.
8140	(d) Mites,	24	T. P. Meyer, Lock Haven.
8147	Garden Spider,	25	H. M. Zimmerman, Derry Church.
8203	Entozoa,	30	Dr. J. F. Kocher, Walberts.
8204	(b) Mites,	30	A. H. Air, Scranton.
	Reptiles, Batrachians and Fishes.		
7937	House Snake,	1	G. A. Spring, Covington.
7940	Common Garter Snake,	1	T. A. Berkey, Easton.
7941	Common Garter Snake,	1	S. J. Bert, Mowersville.
7946	Ribbon Snake,	1	O. N. Shaffer, Hyndman.
7947	Common Garter Snake,	1	Dr. B. W. A. Young, Nisbet.
7949	(a) Common Garter Snake,		
	(b) (2) Box Tortoises,	2	M. M. Brunner, Iron Bridge.
7950	(a) (3) Sculptured Turtles(C. insculptus),	2	R. W. Wehrle, Indiana.
	(b) Leopard Frog (R. pipiens),		
7951	Common Garter Snake,	2	W. H. Bullock, Honesdale.
	(b) (2) Box Tortoises,	2	M. M. Brunner, Iron Bridge.
7962	(a) House Snake,	2	Mrs. E. Schermerhorn, Elgin.
7963	House snake,	2	H. B. McCormick, Harrisburg.
7965	(b) (2) Box Tortoises,	2	M. M. Brunner, Iron Bridge.
7967	Copperhead Snake,	2	A. B. Smith, Shirleysburg.
7971	Common Garter Snake,	3	T. A. Berkey, Easton.

Specimens Received During October—Continued.

Number.	Specimen.	Date—October, 1906.	Name and Address.
7978	(a) Common Garter Snake, ... (b) Box Tortoise, ...	5	Boyertown High School, Boyertown.
7984	Box Tortoise, ...	5	C. Clouser, Williamstown.
7985	Box Tortoise, ...	5	Miss E. Kirchoff, Williamstown.
7986	Painted Turtle (C. picta), ...	5	Jas. Ramberger, Blackwood.
7987	Newt (D. viridescens), ...	5	Jas. Ramberger, Blackwood.
7988	Granite Salamander (P. glutinosus),	5	E. Werdt, Williamstown.
7992	Purple Salamander (G. porphyriticus), ...	6	W. L. Irvine, Loysville.
7996	Common Water Snake, ...	8	J. J. Hardy, Mt. Alto.
7997	Common Garter Snake, ...	8	J. C. Williams, Mountaindale.
8003	Box Tortoises, ...	8	Boyertown High School, Boyertown.
8004	(a) Black Snake, ... (b) Copperhead Snake, ...	8	L. G. Schaum, Womelsdorf.
8005	Pilot Snake, ...	8	M. L. Sheetz, Harrisburg.
8006	(a) Striped Water Snake, ... (b) 3 Common Garter Snakes, ... (c) 2 House Snakes, ... (d) Rock Snake, ... (e) Ring-necked Snake, ... (f) 2 Granite Salamanders, ... (g) 2 Red Salamanders (S. ruber),	8	O. S. Gottshalk, Rahns.
8008	(a) 3 Hellbenders (C. alleganiensis), (b) Mud Puppy (N. maculosus), ..	9	R. W. Wehrle, Indiana.
8010	Rock Snake, ...	9	C. Bongart, Harrisburg.
8011	2 Box Tortoises, ...	9	M. M. Brunner, Iron Bridge.
8012	Box Tortoise, ...	9	A. L. Shea, Easton.
8013	(a) 3 Common Garter Snakes, ...	9	Prof. Sheetz, Mt. Alto.
8017	Common Garter Snake, ...	9	J. Maxwell, Cove.
8018	(a) Common Garter Snake, ... (b) Common Water Snake, ...	10	Misses A. Eastburn and A. Parry, George School.
8023	Box Tortoise, ...	10	M. M. Brunner, Iron Bridge.
8026	4 Common Water Snakes, ... 3 House Snakes, ... 3 Common Garter Snakes, ... Lizards (S. undulatus), ... Red Salamander, ... 3 Spotted Salamanders (A. punctata), ... Blowing Viper, ...	10	Miss Belle Van Sant, George School.
8027	Common Garter Snake, ...	10	Miss Belle Van Sant, George School.
8028	(a) Black Snake, ... (b) House Snake, ... (c) Lizard (S. undulatus), ... (d) Striped Lizard (E. fasciatus),	10	Miss Belle Van Sant, George School.
8030	Black Snake, ...	11	A. H. Hoffman, Carlisle.
8032	Rock Snake, ...	11	J. P. Blake, Fox Chase.
8033	Common Garter Snake, ...	11	L. G. Schaum, Ryeland.
8034	Ribbon Snake, ...	11	P. A. Apple, Middleburg.
8040	Common Water Snake, ...	11	E. Warlington, Harrisburg.
8042	House Snake, ...	12	J. A. Jefferson, Easton.
8051	Common Garter Snake, ...	15	A. Rutherford, Harrisburg.
8052	Red Salamander, ...	15	R. W. Wehrle, Indiana.
8057	(a) 2 Box Tortoises, ...	15	S. and R. Adams, Williamstown.
8058	Box Tortoise, ...	15	J. Joseph, Williamstown.
8059	Box Tortoise, ...	15	Tessie T. Warlow, Williamstown.
8060	Common Lizard (S. undulatus), ...	15	J. Phillips, Williamstown.
8061	Common Water Snake, ...	15	R. Bell, Williamstown.
8065	Rock Snake, ...	15	R. Brough, Harrisburg.
8066	(a) Rock Snake, ... (b) House Snake, ...	15	Miss L. Sheetz, Harrisburg.
8067	Common Garter Snake, ...	15	G. W. Whithill, Etters.
8070	Pilot Snake, ...	15	Kenneth Rineard, Linglestown.
8072	(a) Common Garter Snake, ... (b) Leopard Frog, ...	16	R. W. Wehrle, Indiana.
8073	Common Water Snake, ...	16	J. O. Craig, Greencastle.
8074	Common Water Snake, ...	16	J. R. Tribley, Hilewood.
8076	Pilot Snake, ...	16	J. C. Williams, Mountaindale.
8077	Red-bellied Snake, ...	16	W. Codney, Wellsboro.
8078	Common Garter Snake, ...	16	P. S. Tooker, Easton.
8080	(a) Rattlesnake, ... (b) 3 Common Garter Snakes, ...	16	U. E. Smith, Monroeton.
8083	(a) Box Tortoise, ...	16	J. R. Derr, Arters.
8087	Musk Turtle (A. odoratus), ...	16	F. J. Paine, Harrisburg.
8088	Grass Snake, ...	16	Miss L. Sheetz, Harrisburg.
8090	Black Snake, ...	17	——, Coraopolis.
8091	Ring-necked Snake, ...	17	W. Martz, Williamstown.

Specimens Received During October—Continued.

Number.	Specimen.	Date—October, 1906.	Names and Address.
8092	Granite Salamanders,	17	T. Frew, Williamstown.
8093	Red Salamander,	17	Emma Warlaw, Williamstown.
8094	Red-bellied Snake,	17	Mrs. G. Schoffstall, Williamstown.
8095	Blowing Viper,	17	W. H. Miller, Berrysburg.
8096	Box Tortoise,	17	Boyertown High School, Boyertown.
8100	2 Common Garter Snakes,	18	F. Van Schaack, Harrisburg.
8101	Common Garter Snake,	18	J. R. Hoffert, Harrisburg.
8102	House Snake,	18	J. A. Jefferson, Easton.
8103	Ring-necked Snake,	18	W. Keller, Pottsville.
8104	Pilot Snake,	18	M. Brightbill, Marsh Run.
8105	Sculptured Turtle,	18	L. C. Hassinger, Indiana.
8106	(a) Sculptured Turtle,	18	R. W. Wehrle, Indiana.
8110	(a) Common Garter Snake,	18	D. C. Urich, Penbrook.
8117	Red Salamander,	20	R. W. Wehrle, Indiana.
8118	Common Garter Snake,	20	P. L. Carpenter, Johnstown.
8119	Red Salamander,	21	E. M. Mixer, Waterford.
8121	(a) Common Garter Snake, (b) 2 Salamanders (B. ochrophaea), (c) 10 Brown Salamanders (D. fusca), (d) 35 Red-striped Salamander (P. cinereus),	22	R. W. Wehrle, Indiana.
8122	Common Garter Snake,	22	L. L. Leh, Egypt.
8128	(a) House Snake, (b) 3 Common Water Snakes, (c) 11 Rock Snakes, (d) 10 Common Garter Snakes,	22	Wagner Free Institute of Science, Phila.
8130	2 Common Garter Snakes,	23	R. W. Wehrle, Indiana.
8131	7 Newts,	23	F. R. Knecht, Nazareth.
8132	Leopard Frog,	23	R. W. Wehrle, Indiana.
8137	(a) Common Garter Snake, (b) 11 Brown Salamanders,	24	R. W. Wehrle, Indiana.
8144	Rock Snake,	25	L. R. Metzger, Harrisburg.
8148	Red-banded Salamander,	25	P. R Kreiss, Benjamin.
8151	Rock Snake,	26	J. N. Hobart, Harrisburg.
8152	Common Garter Snake,	26	W. Troup, Harrisburg.
8154	(a) 11 Common Garter Snakes, (b) Ring-necked Snake, (c) Rattle Snake, (d) Copperhead Snake, (e) Striped Water Snake, (f) House Snake, (g) 2 Common Water Snakes, (h) Rock Snake,	26	J. R. Grim, Kutztown.
8155	Common Water Snakes,	26	E. K. Hoch, Kutztown.
8156	Common Garter Snake,	26	W. J. Hellman, Kutztown.
8157	Common Garter Snake,	26	Ruble E. Diller, Emaus.
8158	2 Common Garter Snakes;	26	Katherine Hoffman, Gibra'tar.
8159	Common Garter Snake,	26	Helen S. Seidel, Bower's Sta.
8160	Rattlesnake,	26	H. M. Fisher, Kutztown.
8161	Common Water Snake,	26	N. M. Koons, Kutztown.
8162	Common Garter Snake,	26	E. M. Fox, Kutztown.
8163	Common Water Snake,	26	R. DeTurck Oley.
8164	Striped Water Snake,	26	Ethel Scheffey, Yellow House.
8165	Common Garter Snake,	26	H. F. Grim, Kutztown.
8166	Common Garter Snake,	26	Lulu S Koch, Kutztown.
8167	Common Garter Snake,	26	C. F. Kistler, Kutztown.
8168	Common Garter Snake,	26	J. H. Oswald, Bower's Sta.
8169	Common Garter Snake,	26	Ada C. Hoch, Kutztown.
8170	Common Garter Snake,	26	H. Moyer, Fleetwood.
8171	Common Water Snake,	26	G. B. Rapp, Phoenixville.
8172	Common Garter Snake,	26	Lillian Schuler, E. Texas.
8173	Common Garter Snake,	26	M. Smith Emaus.
8174	Rattlesnake,	26	Mary Faust, Kutztown.
8175	Common Garter Snake,	26	C. Seidel, Kutztown.
8176	Blowing Viper,	26	Solon J. Fegely, Shamrock.
8177	Common Water Snake,	26	Edna A. Gruber, Kutztown.
8178	Pilot Snake,	26	F. O. Keiper, Kutztown.
8179	Ribbon Snake,	26	N. S. Fretz Bedminster.
8180	Grass Snake,	26	E. P. Zeigler, Kutztown.
8181	House Snake,	26	G. Wallower, Auburn.
8182	Common Garter Snake,	26	J. R Yoder, Kutztown.
8183	Common Garter Snake,	26	H. H Bleiler, Kutztown.
8184	House Snake,	26	Eva M. Swoyer, E. Texas.
8185	Common Garter Snake,	26	M. D. Leiby, Kutztown.
8186	Common Water Snake,	26	J. Percell Kutztown.
8187	Common Water Snake,	26	Florence Leidy, Hamburg.

Specimens Received During October—Concluded.

Number.	Specimen	Date—October, 1907	Names and Address.
8188	Common Water Snake,	26	R. B. Jenkins, Tower City.
8189	(a) 2 House Snakes,		
	(b) Common Water Snake,	26	J. H. Bieber, Kutztown.
	(c) Common Water Snake,		
8190	(a) Common Garter Snake,		
	(b) Rock Snake,	26	E. M. Folk, Kutztown.
8191	House Snake,	26	M. Loy, Kutztown.
8192	(a) 4 Ring-necked Snakes,		
	(b) Grass Snake,	26	R. L. Knecht, Tower City.
8195	Rock Snake,	29	Mabel M. Holler, Williamstown.
8196	Grass Snake,	29	H. C. Sallids, Williamstown.
8197	Spotted Salamander,	29	J. J. Maher, Williamstown.
8198	Painted Turtle,	29	F. D. Kebach, Williamstown.
8199	House Snake,	29	Miss Sober, Dauphin.
8212	(a) 3 Common Garter Snakes,	31	Miss Belle VanSant, George School.
8213	(a) Red-banded Salamander,		
	(c) Red Salamander,	31	E. Frank, Johnstown.
	Birds and Mammals.		
7957	Marsh Hawk,	2	M. R. Bower, Landisburg.
7965	Great-horned Owl,	2	M. R. Bower, Landisburg.
7974	Cooper's Hawk,	3	J. Mell, Richland.
7981	2 Chipmunks,	5	Dr. I. H. Mayer, Willow street.
7993	Black Squirrel,	6	J. E. Spencer, Wellsboro.
7999	Blue Jay,	8	A. A. Spencer, Wellsboro.
8007	Red Bat,	8	H. S. Makibbin, Harrisburg.
8029	Blue-wing Teal,	11	L. C. Hassinger, Indiana.
8041	Coot,	12	A. B. Miller Barnesville.
8054	Nest of English Sparrow,	15	Mrs. S. B. Fritz, Duncannon.
8071	Coot,	16	C. H. Yuckenberg, Indiana.
8072	(c) Red-shouldered Hawk,		
	(d) Screech Owl,	16	R. W. Wehrle, Indiana.
8079	(a) Robin,		
	(b) Fox Sparrow,	16	W. J. Bean, Bunkerhill.
8082	Short-tailed Mole Shrew,	16	B. M. Stone, Stull.
8099	Red Bat,	18	J. E. Patterson, Wilkes-Barre.
8107	Gray Fox,	17	J. C. Williams, Mountaindale.
8111	Great Blue Heron,	19	L. C. Hassinger, Indiana.
8133	Wilson's Snipe,	23	Gertrude E. Donohoe, Conemaugh.
8142	Red-tailed Hawk,	25	R. Hench, Eshcol.
8194	Cooper's Hawk,	27	R. W. Wehrle, Indiana.

Specimens Received During November, 1906.

Number.	Specimens—Insects.	Date—November, 1906.	Name and Address.
8215	Lecanium,	1	Z. T. Meixel, Harrisburg.
8218	Collection of Mounted Lepidoptera and Larvæ,	2	H. Hornig, Phila.
8223	Louse Fly from Great-horned Owl,	3	R. Hench, Eschol.
8225	Scurfy Scale,	3	R. E. Rodgers, Sugar Creek.
8226	(a) San José Scale, (b) Lecanium,	3	J. C. Rummel, Shippensburg.
8235	Lady Beetle (P. misella),	7	A. Clauser, Lawndale.
8236	(a) Scurfy Scale,	7	G. W. Harshaw, Parker's Landing.
8239	San José Scale,	7	W. M. Robinson, Danville.
8242	Insects,	7	Anna K. Bewley, Forest Grove.
8244	Tree Cricket Egg Punctures,	7	J. Hopkins, Juniata.
8245	Lecanium,	7	P. W. Shimer, Easton.
8246	Egg Mass of Chinese Mantis (T. sinensis),	7	R. D. Barclay, Haverford.
8249	Bird Lice from Goshawk,	7	C. M. B. Naugle, Lees Cross Roads.
8250	San José Scale,	7	C. Kautz, North Water Gap.
8251	Egg punctures of Seventeen-year Cicada,	7	W. T. Prichard, Mount Nebo.
8252	Polyphemus Cocoon,	8	A. McLaughlin, Rossiter.
8254	Apple Bark Insects,	9	Mrs. Marks, Harrisburg.
8255	Oyster-shell Scale,	10	Waterford Farming Co., Waterford.
8256	(a) Oyster-shell Scale,	10	J. M. Longwell, Brockwayville.
8261	Scurfy Scale,	12	M. F. F. Swartzell, Milroy.
8264	(a) Aphids, (b) Oyster-shell Scale, (c) Katydid Eggs,	12	P. D. Dixson, Uniontown.
8265	San José Scale,	12	E. P. Miller, Altoona.
8267	Work of Carpenter Bee (X. virginica),	12	J. E. Patterson, Wilkes-Barre.
8268	Chestnut Worms,	12	I. C. Williams, Mont Alto.
8269	(a) Polyphemus Cocoons, (b) Promothea Cocoons,	13	J. N. Knull, Harrisburg.
8272	(a) San José Scale, (b) Cicada Punctures,	13	W. B. Billheim, Danville.
8278	(a) Aphis Eggs,	16	H. B. Worrell, Phila.
8279	San José Scale,	16	H. J. Diehl, Pottsgrove.
8281	(a) San José Scale, (b) Stink Bug (Euschistus sp.),	16	Mrs. E. L. Lee, Phila.
8282	Maple Leaf-cutting Moth (I. acerifoliella),	16	Mrs. E. L. Lee, Essex, N. Y.
8287	San José Scale,	19	Mr. Shook, Spring Mills.
8296	Wheat Stem Joint Worm,	20	W. S. Monro, Carlisle.
8299	Spice Beetles (S. panicea),	20	Geo. Pritchard, Harrisburg.
8301	(c) Louse Fly from Barred Owl,	21	J. E. Spencer, Wellsboro.
8303	(a) San José Scale, (b) Scurfy Scale,	22	J. M. Snyder, Chapman's Run.
8304	Drone Fly (E. tenax),	22	H. D. Stewart, Landisburg.
8307	San José Scale,	23	Dr. D. L. Ryder, Chambersburg.
8308	San José Scale,	23	H. F. Russ, Shoenersville.
8313	(a) San José Scale, (b) Scurfy Scale,	24	J. W. Rehmeyer, Shrewsbury.
8316	San José Scale,	24	J. W. Growden, Cumberland Valley.
8317	(a) San José Scale, (b) Scurfy Scale,	24	A. A. Geary, Danville.
8327	Bird Lice on Goshawk,	27	J. N. Cross, Laurel.
8329	Luna Moth Cocoons,	27	M. M. Hildebrant, Mt. Joy.
8331	San José Scale,	27	R. Staudt, Myerstown.
8334	Bird Lice on Downy Woodpecker,	27	Harley B. Surface, Camp Hill.
8337	Polyphemus Cocoons,	30	J. M. Knull, Harrisburg.
8339	Rose Scale,	30	J. B. Tanguy, Westgrove.
8340	Caddis Fly Larva,	30	D. R. Rose, Knox.
	Invertebrates Not Insects.		
8236	(b) Red Mites,	7	G. W. Harshaw, Parker's Landing.
8242	(b) Spider Egg Case,	7	Anna K. Bewley, Forest Grove.
8243	Nematode,	7	C. Harrison, Nebraska.
8273	(a) Mussel (Unio occidens), (b) Mussel (Unio complanatus), (c) Mussel (Unio borealis), (d) Mussel (Unio ellipsis).	13	James Fletcher, Ottawa, Canada.
8275	Tarantula (Mygale Henzii),	15	Geo. H. Cobaugh, Harrisburg.
8283	Spider Eggs,	16	J. Van Schaack, Harrisburg.
8285	Garden Spider,	19	D. P. Carrier Corry.
8312	Leeches,	24	Mrs. G. P. West, Danville.
8320	Mites,	26	W. K. Everett, Roulette.

Specimens Received During November—Concluded.

Number.	Specimen.	Date—November, 1906.	Name and Address.
	Reptiles, Batrachians and Fishes.		
8217	Red-bellied Snake,	2	R. Smith, Myersdale.
8220	(a) 2 Common Garter Snakes, (b) Common Water Snake,	2	A. F. Baver, Krumsville.
8222	Rock Snake,	3	P. S. Tooker, Easton.
8223	Blacksnake,	5	F. M. Gruber, Kutztown.
8242	(a) Blacksnake,	7	Anna K. Bewley, Forest Grove.
8274	(a) Red-banded Salamander,	7	H. Harker, Jr., and L. E. Satterthwait, Westtown.
8286	(a) 4 Water Dogs,	19	R. W. Wehrle, Indiana.
8289	Common Lizard (S. undulatus),	19	——. Landisburg.
8291	Water Dog,	20	R. W. Wehrle, Indiana.
8294	Spotted Salamander,	20	C. F. Rugaber, Galeton.
8299	(a) Rock Snake,	20	G. Pritchard, Harrisburg.
8300	2 Hellbenders,	21	R. W. Wehrle, Indiana.
8302	Common Garter Snakes,	21	F. Van Schaack, Harrisburg.
8305	Hellbender,	22	Dr. A. E. Ackerson, Penn Run.
8311	(a) 2 Snapping Turtles,	24	G. L. Meyer, Mahaffey.
8321	(a) Ribbon Snake, (b) Red Salamander, (c) 4 Newts,	26	F. D. Keboch, Williamstown.
8322	2 Common Water Snakes,	26	E. S. McCartney, Boothwyn.
8323	10 Newts,	26	E. S. McCartney, Boothwyn.
8324	(a) Common Garter Snake, (b) Rock Snake,	26	E. M. Sibson, Fernhill.
8328	Red Salamander,	27	B. Riddle, Elberta.
	Birds and Mammals.		
8223	Great-horned Owl,	3	R. Hench, Eshcol.
8224	Great-horned Owl,	3	J. E. Gaul, Marienville.
8227	Purple Grackle,	5	J. N. Hobart, Harrisburg.
8234	American Bittern,	7	R. W. Wehrle, Indiana.
8241	American Goshawk,	7	O. E. Haas, Almont.
8249	American Goshawk,	7	C. M. B. Naugle, Lees Cross Roads.
8259	Wood Rat,	10	Dr. H. D. Moore, New Lexington.
8262	Star-nosed Mole,	12	W. W. Climenson, Honeybrook.
8270	American Goshawk,	13	W. Stewart, Landisburg.
8276	American Goshawk,	15	——. Stroudsburg.
8295	Grey Squirrel,	20	L. A. Shumway, Charleston.
8301	(a) Long-tailed Weasel, (b) Barred Owl,	21	J. E. Spencer, Wellsboro.
8314	Flying Squirrel,	24	L. S. Moyer, Jonestown.
8315	Crop contents of Grouse,	24	Mrs. R. S. Hampton, Titusville.
8327	American Goshawk,	27	J. N. Cross, Laurel.
8332	Rabbit showing Albinoism,	27	F. M. Lutz, Cambria.
8334	Downy Woodpecker,	27	Harley B. Surface, Camp Hill.
8335	Long-tailed Weasel,	30	W. B. Ranck, Warfordsburg.
8336	Tufted Titmouse,	30	J. Couch, Hickory.

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PLATES FOR THE FEBRUARY MONTHLY BULLETIN OF THE DIVISION OF ZOOLOGY.

LIII. Lady Beetles devouring San José scale. Loaned by U. S. Department of Agriculture.

LIV *a*. Male San José scale, greatly enlarged, Drawn by W. R. Walton.

LIV *b*. Conical Strainer (Original).

REPORTS OF PERSONAL EXPERIMENTS.

Experiment for Destruction of the Flea Beetle (Haltica) on Potato.

The Flea Beetle is a little hard-shell insect or beetle, dark or brownish in color, and somewhat resembling a flea, which sits on the leaves of plants especially those growing near the ground, biting small holes in the upper surface of the leaves and jumping like a flea when disturbed. They often attack potato vines to such an extent as to make the leaves have a brownish appearance from a distance but when viewed from closer range they look as though covered with brown specks. This pest consequently does a great deal of damage to the leaves of the plants when they are so numerous but too often they are ignored and their results only are observed and thought to be due to some kind of blight or leaf disease. It is important to watch them closely, especially shortly after the leaves appear as such pests are particularly injurious to very young foliage. A single bite by an insect in a small leaf before it is unfolded may result in deforming or otherwise seriously injuring the entire leaf by the time it should be full grown and expanded.

In my Bulletin on "Insects Injurious to Curcurbitaceous Plants," special bulletin No. 96 of the State Department of Agriculture, it is shown that it is possible to drive flea beetles with the wind against boards covered with tar, thus trapping them in great numbers. It is also known that it is possible to drive them away or repel them with Bordeaux Mixture. This is not because the Bordeaux Mixture is an insecticide but because it acts in this case as a repellent. The important feature in dealing with the Flea Beetle is to destroy weeds and other plants on which they find sustenance, and also destroy all rubbish and debris in which they find protection during their hibernation or winter period.

Our experiments for this pest were performed by Mr. C. E. Myers, using combination of Soda Bordeaux and Paris Green, which is to be recommended for both blight and leaf-eating pests. The plants were well sprayed once only, on the 15th of August, when the beetles were quite numerous on the potato leaves and their work was plainly manifested in the form of many very small round dots where they had eaten through the epidermis of the leaves.

The formula for the material used was as follows, Paris Green, one ounce; Copper Sulphate, four-fifths pound; Washing Soda, two pounds; water, ten gallons. The copper sulphate was dissolved in the water and the common washing soda was added in quantities suf-

ficient to neutralize the blue stone. Then the Paris green was stirred to a paste in a cup with enough water to make it pasty or mushy, and was then stirred into the ten-gallon solution. Before the poison was added it was what we call Soda Bordeaux. After the addition of the Arsenite it was Soda Bordeaux with Paris Green, and was thus both a fungicide for certain plant diseases and an insecticide for chewing insects.

On August 17th the leaves were examined and very few beetles indeed were found upon them. Either they were practically all killed or driven away, which amounts to the same as far as the results on the potatoes are concerned.

As this was the same material that is recommended for both blight and potato beetles, it is to be seen it will prove useful and a good general material for application to potatoes in this State. The foliage of the potato plants were entirely uninjured, although there was a slight dustlike deposit or coloration, showing where the material was applied. Thus the experiment, although not extensive, is important in its results and gives to our potato growers an indication that they should heed. We hope next season to conduct such experiments more extensively, and publish details of expense of both time and material, together with actual profits from spraying varying numbers of times, as shown by yields of check rows or untreated rows.

AN APPEAL TO FARMERS, TEACHERS AND NATURE-LOVERS.

Let us not compel Prof. Surface and his department to do all the labor in the awakening of this Commonwealth to new agricultural conditions as affected by its zoological relations. Such labor would prove too great. It would require martyrdom to the cause to do it, and perhaps even then failure would result. The Zoological Department is now doing a truly wonderful work, but it cannot reach the masses without your help and mine. If you have been benefited, why not aid some one else to find similar benefits?

I have noted a few ways in which you can aid in this important work:

1. By moulding sentiment for it in your community.
2. Co-operating individually by collecting and transmitting specimens desired.
3. Putting into practical use those instructions and hints which bear directly on your own conditions.

4. Sending to Prof. Surface the results of your trials of such instructions.

5. Being a little patient for results, as your application may at first be faulty.

6. Starting a project for a collection of local natural objects for exhibit at your grange, club or society meeting, school, County fair, or teachers' institute, and forwarding same later to the department, together with notes, for study and preservation.

7. Distributing relevant literature at such gatherings.

8. Organizing clubs for Nature-Study among boys and girls.

9 Including at least one lecture on nature in each local lecture course.

10. Petitioning your legislators for a State Nature-Study Bureau and the incorporation in the course of study in rural schools of the elements of agriculture.

11. Enforcing the Game and other laws bearing on economical agriculture.

By such co-operation from farmers, teachers and Nature lovers, Pennsylvania can be placed in the lead for the best conditions in this direction, and each will have the satisfaction of knowing that he or she has contributed to a very real betterment as a legacy for posterity.

C. LEON BRUMBAUGH,
Manager of the Burroughs Club of America.
Wilkinsburg, Pa.

FOR PESTS IN BEANS, PEAS, GRAINS AND OTHER SEEDS.

Persons having seeds of any kind, especially beans and peas, stored for planting or for use, should not permit them to remain without examination to see if pests be in them. Break some open and see if they be infested with weevils or similar pests, and if so give them at once a treatment by putting them into a vessel that can be tightly closed, such as a barrel, and set on them a saucer into which should be poured from a quarter to a half pint of Carbon Bisulphide or Bisulphide of Carbon. The barrel or vessel should be closed tightly, either with a tight-fitting lid or with wet blankets. The latter is very effective and speedy and obviates the necessity of a tightly fitting cover. Keep the vessel closed for at least a day or longer and the pests will all be killed.

Perform this work in an out building and not in the house where persons are living. Keep fire away from the liquid and its fumes,

as they are explosive and about as dangerous as benzine and gasolene but not more so.

It is sometimes more convenient to put the seeds that are to be treated into sacks and set the sacks into the barrel or vessel where the fumigation is to take place. Where there are several kinds of seeds to treat this can successfully be done by placing each kind in a sack and setting the sacks altogether in the same barrel. Carbon Bisulphide does not injure the seeds or grain for growing or for food. But it will kill the pests and thus aid in preventing large numbers the following year.

BEE HINTS.

Keep the hives protected from wind, rain and sunshine. The best way to do this is to slip over them a cap made of tarred paper, such as is commonly used for roofing or lining, tacking it on the outside lid that is a little larger than the hive in such a way that the lid or board cover will keep out the rain and hold it in place. Of course, it should before tacking, be folded in the shape of a hive, and be made of such size that it will slip easily over it, like a box turned up side down.

Learn if the bees have plenty of food. This should be at least fifteen pounds of stores at this time of year. To determine this weigh an empty hive, and then weigh all those with Bees in them. Allow about five pounds for the weight of the Bees and comb and moisture. Therefore, if the weight of the hive with Bees be less than about twenty pounds, not including the weight of the hive itself, the owner should then prepare to feed them at once.

Early spring feeding will be found very beneficial for all light or weak colonies, and also for those that have reduced or scanty stores. Prepare the food by making a cake of hard dry candy, and place it in the super or box over the hive and under a chaff cushion with which they are protected during the winter and spring. This means that the food should lie on the frames directly over the cluster of Bees where they can get at it without coming out for it.

Make the bee candy by boiling granulated sugar (white) in water until it has reached the condition where it will form a hard string as it drops from the spoon or where it will become hard when dropped into cold water. In other words boil it until it reaches the stage that is considered right for making fudge. Then stir it in a pan while cooling until it becomes grainy. It should not be stirred

until it is entirely cold and will not stick together as it should not be fed to them when pulverized, but it should be in a granulated condition and yet in the form of a block, not more than an inch thick, and as wide and long as the owner may wish to use, although it should not fill all the space under the chaff cushion.

This early feeding stimulates the queens to lay, and is one of the first important steps toward building up strong colonies in the spring as well as carrying colonies through the winter, which would be about starved at this time of the year if not given care. Many colonies of Bees which are yet alive will be found dead within a few weeks from starvation if not fed soon.

FACTS AND TREATMENT OF SAN JOSÉ SCALE.

The most complete discussion which this State has ever published on the San José Scale is to be found in our Monthly Bulletins for November and December, 1906, but as the supply of the November Bulletin is now exhausted, it is necessary to give a condensed statement of the facts contained therein, and those persons who desire the December Bulletin, which deals with other materials than the Lime-sulfur Wash for the San José Scale and also with apparatus, causes of failure, other kinds of scale insects, etc., may obtain it free of charge by writing to us for it.

The San José Scale is an insect which destroys many thousands of dollars worth of fruit trees, shrubbery, and other kinds of trees in this State by injecting a severe poison into them, and also by sucking their sap. It feeds entirely by sucking and not by chewing, and hence it is not to be killed by internal poisons. The name comes from the city of San José, California, where it was first introduced into this country, from which State it was brought to the Eastern nurseries, and next scattered over the State of Pennsylvania on nursery stock, beginning about 1891. Its native home is China, where it is held in check by its enemies, but it has not yet been possible to introduce these successfully into this Country. Some Lady Beetles feed upon it, and it has a few other enemies, but they are not yet sufficiently numerous or effective to control it (See plate LIII).

The San José Scale bears living young and multiplies so rapidly that it has been estimated (U. S. Bulletin No. 3, page 44) that one individual can become the ancester of three billion two hundred and sixteen million, eighty thousand and four hundred (3,216,080,400) in

one season. They are carried by natural means only in the young and free-moving stage, which is during the first day or two of their existence. During this time they crawl about seeking a suitable place to insert their beaks through the bark, and then become fixed and secrete a waxy water proof covering, which is the scale that covers the yellow, soft-bodied insect and which, itself, is not as large around as a pin head, but perfectly circular in shape, with a little tip or point in the middle, which is surrounded by a small depression like a ditch. These distinguishing characters are to be observed only by the use of a microscope.

In its fixed or adult stage this insect is carried only upon wood, that is going to grow again, such as young trees that are being transplanted, or cuttings for buds or grafts. As it commences to bear its young about the 10th of June, and continues this day and night until December, if the weather be warm, it must be seen that it is naturally spread during this entire period by winds, birds, cats, squirrels, live stock, intertwining branches, larger insects which fly from tree to tree, and by any other agency that would carry it (while it is yet free-moving) to any plant on which it may feed. However, during the remainder of the year, which means during the winter and spring months, it is not spread nor carried, excepting on wood that is to grow again, and this means that it is not necessary to burn the trimmings of infested trees that are cut off when pruning in the spring, because the scale dies shortly after a branch is cut off on which it may be found and even before the tree dies.

The male San José Scale (Plate LIV) transforms to a winged stage when fully mature and is able to fly, although it is very delicate, minute, light-colored insect, and the female never develops wings. In the young or free-moving stage these pests are as easily killed as plant lice, but in the protected or older stages severe contact applications must be used. When very young or free-moving mild insecticides that will not in the least injure the foliage can be used against them, but when older it is impossible to destroy them without injury to the foliage, if the trees be in leaf.

For this reason, practically all effective applications against the San José Scale must be made when the leaves are off, in order to apply materials strong enough to kill the fixed individuals and not hurt the trees.

It is too commonly believed that this insect attacks all kinds of trees and ornamental shrubbery, but this is not true. It is bad enough to have to say that there are about seventy species of woody plants that may become badly infested by the San José Scale in this State, and about the same number that are only occasionally or rarely infested, which means that when the plants of this second list are growing near those belonging to the first, which have the

San José Scale on them, it is carried to those of the second and will feed and exist on them but not to a destructive extent. However, the most of the native woody plants, such as the larger number of the forest trees, have not been seriously attacked, and at present there need be no alarm about its destroying many kinds of shade trees along streets nor most of the forest trees. It is surely enough to remember that it will certainly destroy practically all fruit trees (excepting the Sour Cherry) and many species of ornamental trees and shrubbery. We publish below the two lists of plants which it is known to attack, and those not in these lists may be considered as practically free from this pest:

Plants Commonly and Rarely Known to be Infested with San José Scale:

(From Second Report of the State Entomologist of Connecticut—W. E. Britton, State Entomologist.)

1. List of Hardy Trees, Shrubs and Vines Commonly Infested.

Acacia, sp.
Akebia, sp.
Akebia quinata.
Almond, (Prunus amygdalus).
Almond, Flowering, (Prunus Japonica).
Apple, (Pyrus Malus).
Apricot, (Prunus Armeniaca).
Ash, American Mountain, (Sorbus, sp.).
Ash, European Mountain, (Sorbus aucuparia).
Basswood, Linden, (Tilia, sy.)
Beech, European or Purple-leaved, (Fagus sylvatica).
Cornus Baileyi.
Cornus sanguinea.
Cotoneaster, sp.
Cotoneaster vulgaris.
Crabapple, (Pyrus, sp.).
Crataegus cordata.
Crataegus Crus-galli.
Currant, (Ribes rubrum).
Currant, European, (Ribes nigrum).
Currant, Flowering or Missouri, (Ribes aureum).
Cherry, Choke, (Prunus Virginiana).
Cherry, Sand, (Prunus pumila).
Cherry, Sweet, (Prunus Avium).
Cherry, Wild Black, (Prunus serotina).
Dogwood, White, (Cornus alba).
Elm, (Ulmus, sp.).
Elm, American, (Ulmus Americana).
Elm, European, (Ulmus campestris).
Gooseberry, American, (Ribes Oxyacanthoides).
Hawthorne, (Crataegus, sp.).
Hawthorne, English, (Crataegus Oxyacantha).
Hoptree, (Ptelea trifoliata).
Japanese Quince (Cydonia Japonica).
Juneberry or Shadbush, (Amelanchier Canadensis).
Lilac, common, (Syringa vulgaris).
Lilac, Persian, (Syringa Persicæ).
Linden, American or Basswood, (Tilia Americana).
Orange, Sour, (Citrus trifoliata).
Orange, osage, (Toxylon pomibrum).
Peach, (Prunus Persicæ.)
Pear, (Pyrus communis).
Pear, Sand, (Pyrus sinensis).
Plum, Beach, (Prunus maritima).
Plum, European, (Prunus domestica).
Plum, Japanese, (Prunus triflolata).
Plum, Purple-leaved, (Prunus Cerasifera).
Plum, Wild Goose, (Prunus hortulana).
Poplar, (Populus, sp.).
Poplar, Carolina, (Populus deltoides).
Poplar, Lombardy, (Populus nigra, var Ital.).
Privet, common, (Ligustrum vulgare).
Quince, common, (Cydonia vulgaris).
Quince, Flowering or Japan, (Cydonia Japonica).
Rose, (Rosae, sp.).
Rosa Carolina.
Rosa mucida.
Rosa Virginina.
Rosa rugosa.
Salix lucida.
Sand Cherry or Dwarf Cherry, (Prunus pumila).
Siberian Crab, (Pyrus baccata).
Scarlet Thorn, (Crataegus coccinea).
Snowberry, (Symphoricarpus racemosus).
Thorn, common, (Crataegus Crus-galli).
Walnut, Japanese, (Juglans Sieboldiana).
Willow, (Salix, sp.).
Willow, Laurel-leaved, (Salix petandra).
Willow, Prairie, (Salix humilis).
Willow, Weeping, (Salix Babylonica).
Willow, Yellow, (Salix vitellina).

2. Hardy Trees, Shrubs and Vines Occasionally or Rarely Infested.

Actindia arguta.
Alder, (Alnus, sp.).
Althea, (Hibicus Syriacus).
Arborvie, (Thuya occidentalis).
Ash, (Fraxinus, sp.).
Ash, White, (Fraxinus Americana).
Birch, (Betula, sp.).
Birch, Cut-leaved or White, (Betula alba).
Blackberry, common, (Rubus nigrobaccus).
Box, (Buxus, sp.).
Catalpa, common, (Catalpa bignonioides).
Cherry, Sour, (Prunus cerasus).
Chestnut, (Castanea Americana).
Chestnut, Horse, (Aesculus Hippocastaneum).
Cornus alternifolia.
Cornus Amomum.
Cornus candidissima.
Cornus circinata.
Cornus stolonifera.
Deutzia, (Deutzia, sp.).
Dewberry, (Rubus villosus).
Dogwood, Flowering, (Cornus Florida).
Eleagnus, (Eleagnus, sp.)
Elder, (Sambucus, sp.).

Eucalyptus, (Eucalyptus, sp.).
Euonymus, sp.
Fig, (Ficus Carica).
Forsythia, sp.
Globe Flower or Japanese Rose, (Kernia Japonica).
Grape, (Vitus, sp.).
Hackberry, Celtis occidentalis).
Honeysuckle, (Lonicera, sp.).
Japanese Magnolia, (Cercidiphyllum Japonicum).
Jersey Tea, (Ceanothus Americana).
Laurel, Mountain, (Kalmia latifolia).
Locust, (Robinia sp.).
Locust, Honey, (Gleditschia Triacanthos).
Maple, (Acer, sp.).
Maple, Norwal, (Acer platanoidese).
Maple, Sugar, (Acer saccharinum).
Maple, Weir's Cut-leaved, (Acer sacc.).
Mulberry, (Morus, sp.).
Mulberry, Weeping, (Morus, sp.).
Ninebark, (Physocarpus opulifolius).
Orange, (Citrus Aurantium).
Pecan, (Hicoria Pecan.)
Persimmon, (Diaspyros Virginiana).
Photinia villosa.
Privet, California, (Ligustrum ovolifolium).
Raspberry, Red, (Rubus strigosus).
Rhodotypos kerrioides.
Sassafras, (Sassafras officinale).
Smoke Bush, (Rhus cotinus).
Sorbaria sorbifolia, (spiraea sorbifolia).
Spiraea, (Spiraea, sp.).
Spruce, White, (Picea alba).
Sumac, (Rhus, sp.).
Silver Thorn, (Elaegnus longipes).
Virginia Creeper, (Ampelopsis quinquefolia).
Viburnum, sp.
Walnut, Black, (Juglans nigra).
Walnut, English or Persian, (Juglans regia).
White Rod or Appalachian Tea, (Viburnum cassinoides).

There are many reasons why this is more destructive than other insects, among which are its more deadly poison, its small size, and the consequence that is is not generally seen until the trees are dying from it, its rapid rate of multiplication, its wide range of food plants, its multiplication by bearing living young continuously and thus being spread day and night during nearly half the year, its entire freedom from internal parasites, its ability to stand the severe winter weather in this State, the impossibility of killing it or ridding the trees of it during the summer time without entirely destroying the foliage and thus injuring the trees, and the general absence of enough parasites or insects feeding upon it to a sufficient extent to hold it in check.

Notwithstanding the above statements this pest can be controlled by artificial means, as is proven by the many letters and references which are published on later pages of this Bulletin. The chief point in this operation is to cover the trees entirely with an insecticide that is strong enough to kill the pest by contact, but will not have injurious effects upon the tree or bush thus treated. Where the plants are small they may be painted with a brush, or where they are of such nature as to stand cutting back severely without injury, such as the peach, they can be cut back to stubs and painted with brushes, using the insecticides mentioned later, and first class results can be obtained by such methods. The usual method of applying insecticides to infested trees is by the spray pump for the reason that the entire tree can be coated in a short time and without great expense when the material used is in the form of a spray. (For full discussion of apparatus see our December Bulletin, 1906).

Fumigation with a deadly gas is a very successful means of treating trees for this pest, but the apparatus is too expensive, as this must be practically an air-tight tent or box to cover the infested tree or shrub, and is also a very slow method in comparison with spraying.

Treatment for Scale.—The best and cheapest known treatment for the San José Scale is spraying with the boiled Lime-sulfur Wash. Notwithstanding what agents and manufacturers of commercial in-

secticides may say, this is proven (1) by our experiments and observations, (2) by the experiments and publications from nearly every Experiment Station in the Union, and (3) by practical men all over the State, to be absolutely established and true. The formula for the Lime-sulfur Wash is as follows:

Lime, 22 pounds,
Sulfur, 17 pounds,
Water, 50 gallons.

Put the Lime and Sulfur together with enough water to boil, stir occasionally, boil one full hour, strain and add enough water to make the fifty gallons required in the formula, and spray it entirely over the trees in such a way as to leave no spot uncovered. This is all there is to it. There is no special "trick" about the methods of boiling or spraying, and the proportions of Lime and Sulfur may be increased or decreased, and the amount of water may be varied, especially by making it less, if one should wish, and good results will ensue.

Important points.—There are three important points in the control of the San José Scale. (1) One is to boil the material by hard boiling for at least three-quarters of an hour. It is not necessary to boil it over an hour. (2) The next is to strain it through a wire strainer with meshes as small as twenty-six to thirty to the inch. We use with most satisfaction a strainer made of brass wire cloth with twenty-eight wires to the inch. Such brass wire cloth can be bought of Hall and Carpenter, Tin Plate Mfgs., of Philadelphia, and perhaps of many other hardware dealers. Careful straining will prevent clogging of the nozzles, and by straining by the methods we here describe we have been able to spray for an entire day without clogging the nozzle and without trouble from sediment or otherwise.

In making the strainer do not put the wire cloth flat in the funnel, as for a milk strainer, but have it made in the shape of a cone, and stand it upright inside the funnel, so that the base or large end of the cone comes down into the narrow part of the inside of the funnel, and the point of the cone stands up toward the middle of the large part of the funnel. It is a good plan to solder into the funnel a supporting frame-work of larger galvanized wire cloth, about four wires to the inch, and by putting the brass wire cloth over it. This makes what we call the conical strainer, and through it the Lime-sulfur Wash will run like water. When it fills up around the base of the wire cone, the sediment can be turned out of the funnel or water can be run through it to help clean it. If desired, this sediment can be put back for further boiling, or it can be put

around the bases of peach trees, about one quart around the base of each tree to kill the Borers and keep them out or it can be thinned with water and painted by hand on the trunks and larger branches of trees to kill the Scale insects it touches.

The third important point with the Lime-sulfur Wash is to spray it over the trees thoroughly, remembering that in many cases the San José Scale is so abundant on the infested tree that it is impossible to touch the bark with the point of a pin wihout at the same time touching one or more than one of these pests, and it is necessary to cover every one in order to kill it.

After the tree is sprayed and becomes dry enough for the operator to see what spots have been missed, it is necessary for him to go over it again and give it a second or retouching spraying, being sure that every particle of the bark from the tips of the most remote twigs to the base of the trunk is coated very thoroughly.

Two good coats applied in this way in the spring just before the buds burst are all that is necessary to control the San José Scale and will be found to be the best possible step also for the control of most fungus diseases of plants. One application of the Lime-sulfur Wash to peach trees, applied as a thorough double coat as described, will be enough to prevent the Peach Leaf Curl for that season as well as to clean up the San José Scale in a satisfactory manner and destroy many other insects as well as "germs" of fungous diseases. This is one advantage of this material over those commercial insecticides that are sold under the general name of "soluble oils."

If the wind be blowing, it is necessary to spray one side of the tree only, and wait until the wind changes its direction so that the other side can be treated. It is impossible to do a good and satisfactory or successful job of spraying when the wind is blowing. It is possible to have it half done, or in other words do one side, even in a fairly strong wind, but we can not spray against such wind. Another great advantage of the Lime-sulfur Wash is that it leaves a mark, like dilute white wash, where it is applied, and thus the operator and the owner have indications of any spots that have been missed. This is an important point where the owners of trees hire other persons to treat them. It is possible for the operators of spray pumps with commercial insecticides to do spraying in a very poor and unsuccessful manner without any visible evidence at the time that the work has been perfectly done. However, if they be using the Lime-sulfur Wash, any portions of the trees, whether twigs or trunk, that are not covered with this material will remain dark after the liquid is dry and the other portions become whittish, and the operator should go over it again and give it a second or retouching coating, especially on the dark spots,

before he is justified asking pay for his services or expecting satisfactory results.

A great many persons who have had successful results in spraying in this State and elsewhere have done so by means of the boiled material, well strained and thoroughly applied. These are the three most important points to be observed. Note voluntary testimonials on later pages.

The Lime.—It is best to use the form of Lime that is known as Calcium oxide, which gives a brick-red color when boiled, rather than the Magnesium, which gives a dark olive muddy-green color.

The Sulfur should be either the Flour or Flowers, and not the stick Sulfur, commonly known as Brimstone. The last-named is the only form that does not give good results, and this is because the large sticks will not dissolve, even by prolonged boiling. Sulfur should be purchased of local dealers for about three cents per pound when bought in sacks or in barrels. It can be purchased, f. o. b. in Philadelphia, Baltimore or New York, at about $2.40 per hundred pounds. We shall be glad to send the names and addresses of dealers in these cities to persons who are enough interested in the subject to write to us for them. We can also give information as to where the conical strainer can be made for one dollar, and sent to any order for this price plus the expressage.

The Salt is not a necessary ingredient in the Lime-sulfur Wash, as we can certainly kill the scale without it. When applied in the spring it does no injury, but is an added item of expense and trouble. The addition of other substances, such as Bluestone for increasing the fungicidal effects, and poisons or oils to increase the insectical effects, is entirely useless and it is not recommended.

Boiling.—There is no special outfit needed for boiling the Lime-sulfur Wash. The only point to observe it to avoid using copper which it will destroy. Iron kettles are commonly used and a sheet iron hog scalder is excellent, while a common galvanized iron wash tub will serve very well for this purpose.

It is best, however, to make the boiling vat or pan of sheet iron for the lower edges and sides, and the sides further built up with boards to the desired height. The shape of this will be like a cigar box or common paste board box, and it can be set flat upon stone walls built around the fire like a rough furnace, and wood can be used which is too knotty to be cut into stove wood or might otherwise be useless. It is necessary to boil it well from three quarters of an hour to an hour, and it is not necessary to stir it all the time. Stir it enough to keep it from sticking to the bottom and burning. Where steam is to be had as from an engine or steam furnace of some kind, so that the steam will escape near the bottom of the inside of the barrel and boil in this way, no stirring is neces-

sary. Where much material is to be used it is desirable to construct the boiling plant on a hillside where the liquid will run from the barrel to the spray tank by gravity and relieve the necessity of dipping. It is not necessary to go to the trouble of using hot water for diluting the boiled mixture, as cold water gives as good results. Spray while warm, but need not be scalding hot.

Commercial Insecticides.

Due to the activity of agents and manufacturers of commercial insecticides in advertising these substances we are now receiving many questions concerning their merits and publish this as a general reply. Most of these commercial preparations belong to the so called "soluble oils," among which are the Target Brand Scale Destroyer, Kill-o-scale and Scalecide. Another sold as Salimene is evidently a preparation of the Lime-sulfur Wash. These are the chief commercial insecticides with enough claims to merit or justify their existence, while there are a great many less advertised materials, and many of them are far less meritorious. The great objection to some of the commercial insecticides is not that they fail to kill the scale, and not that they injure the trees to which they are applied, but that they are so expensive when used srong enough to really kill the scale that it is out of the question to recommend or employ them except on a few choice trees where one can not readily find facilities to do the work of boiling the lime-sulfur wash. Most commercial insecticides are recommended by advertisers to be used in proportions of one part of the preparation in twenty of water, but our experience, as well as that of other persons, has determined that this is too weak and will not give satisfactory results. The publications of the New York State Experiment Station, and in fact of several other State Stations, have shown these materials should be used in the preparation of one part of the insecticide to 12 or 15 of water, and not more dilute. This makes some of them cost fully 10 times as much as the Lime-sulfur Wash, and it should also be remembered that the oil preparations do not act as fungicides as does the Lime-sulfur Wash, and not being visible upon the trees do not make it possible for operators and owners to see what spots are missed and consequently must be retouched in order to insure satisfactory results.

Certainly the San José Scale can be killed without injury to the trees by the application of some of these commercial insecticides when they are used strong enough to give good results, but this must be at a greatly increased expense and also without the fungicidal action when the oils are used.

With these points in mind, owners are recommended to try to a limited extent such substances as they have in mind, and note the results by careful examination of the trees and comparison some months later with others well covered by the boiled lime-sulfur wash.

We are willing to make inspections of twigs from trees which owners may number at the time they are sent to us, and report percentages of scale alive. We can then tell whether the San José scale is dead or living, and what per cent. are dead at the time of examination.

It is practically impossible to determine this without the use of a microscope, and for this reason inexperienced persons are not justified in making a report upon the results of any treatment for scale insects until some months afterward, when they can see if the pests continue to develop and increase or if they decrease and the trees become more vigorous.

SUMMARY OF RESULTS BY ORCHADISTS IN CONTROLLING SAN JOSÉ SCALE IN PENNSYLVANIA.

It is important for the public to know what has been undertaken and what accomplished in the effort to aid the people of Pennsylvania in the work of saving their trees and crops, as well as much of the ornamental shrubbery and other property from destruction by pests, especially by the San José Scale. For this reason a synopsis of the work by Counties is here given, with a few practical letters or typical letters, just as received from correspondents in some of the fruit-growing Counties, and also references to those persons who have succeeded in controlling the San José Scale by the methods which this office has advocated. These direct references are of considerable value as any person can go directly to the place nearest his residence to see the results of the treatment for the San José Scale. However, it should not be inferred by any means that all who have had good results by the treatment of trees infested with San José Scale with the Lime-sulfur Wash or with other insecticides have written to us on the subject. We wish they would do so. We are making a careful study of the different materials that are being used in the hands of non-professional men and the results that are being obtained in the control of pests, and consequently we desire reports giving information on (1) the time of year, (2) method of application, (3) kind of material used, (4) what percentage was applied, (5) pests treated, (6) kinds of trees or plants, (7) effects on plants, (8) effects on the pests, (9) cost of material for treatment, (10) the

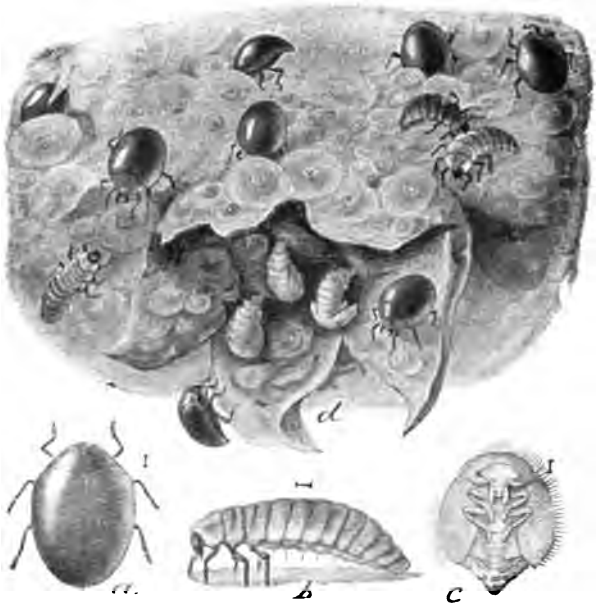
cost of application, (11) date of inspection of results, and, (12) remarks. If each person taking part in the work of treating plant pests should thus give his results, we could know exactly what can be expected of various materials in the hands of the novice and would be safe in making deductions that would be helpful to others, both in giving warning concerning certain materials that are either ineffective or destructive to the plants, as well as in reporting upon those materials that have given satisfactory results.

Of course, we are conducting experiments along the lines suggested above and giving the results of at least one experiment in each of our Monthly Bulletins, but it is possible that the results obtained by careful experimenters, who are accustomed to following the principles of accurate laboratory methods, may be quite different from those of practical fruit grower, who must do the best he can without special training, and particularly is obliged to as much time and money as possible in trying to obtain the desired results.

Just two years ago the Legislature made provisions for the special work of suppressing pests of plants, by legal enactment and appropriation. The duties of executing that Law were placed upon the Secretary of Agriculture, acting through the Economic Zoologist. It is easy to enact Laws, but in many instances very difficult to enforce them in an efficient and satisfactory manner. In this case it was entirely new work that was to be done, and the methods must be devised and executed. As with all pioneer efforts, mistakes were liable to be made, even though with the best of intentions. Experimental measures were not sure to give the results desired, and we could only undertake what might promise to yield valuable returns.

After a conference in the office of Governor Pennypacker, in consultation with many prominent agriculturists, fruit growers, agricultural writers and prominent business men, it was decided best to take up the work by sending inspectors directly into the orchards in this Commonwealth to learn where serious pests are at work, and tell the owners if their trees were infested, and also give demonstrations showing them how to prepare and apply proper remedies to preserve their trees, shrubbery and crops.

The inauguration of this work was a immense undertaking, as competent men must first be obtained and then given the special training which is necessary for this particular kind of work. About thirty men were taken to the Pennsylvania State College and given training both by lectures and by practical orchard methods, bearing chiefly upon the San José Scale and other scale insects. These men became competent to detect the San José Scale with accuracy when found upon any plant, and they were also instructed by practical object lessons in the methods of making and applying insecticides,



LIII. Lady Beetles (*Pentilia misella*) devouring San José scale. By Howard, in Bulletin No. 3, Technical Series, Division of Entomology, U. S. Department of Agriculture. Loaned by U. S. Department of Agriculture, Washington, D. C.

LIV *a*. Male San José scale, greatly enlarged. Drawn by W. R. Walton, Artist in Office of the Economic Zoologist, Harrisburg, Pa.

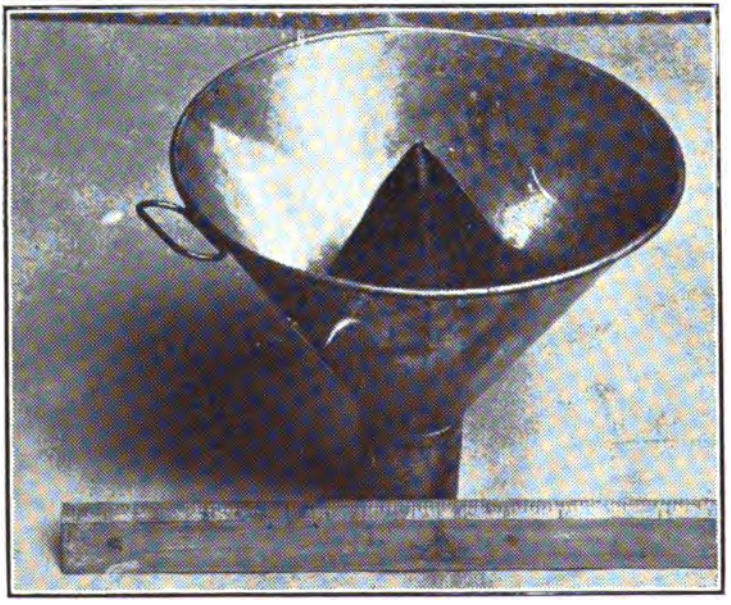


Plate LIV *b*. Conical Strainer for straining Lime-Sulfur wash easily. Made under the direction of the State Zoologist and photographed in his office.

which are known to control this and similar pests in a satisfactory manner, without injury to the plant upon which they may be found.

These men were equipped with good microscopes and were sent into various districts of the State. Nearly all of them were greatly interested in the work, seeing its immense importance, and made unusual efforts to render the service that our agricultural people needed. All persons concerned were gratified to know that they were successful in such efforts, and in general were most cordially received and aided. A few of the inspectors did not find the work congenial or for other reasons dropped out of it, and new men were substituted after having been given special training in the office of the Economic Zoologist at Harrisburg.

In the reports by Counties published on a later page of this Bulletin, it is shown that sometimes different inspectors are named for the same County, but this does not mean that they were confined to the same territory, inspecting the same orchards nor working in the district at the same time. It may mean that at one time the one inspector had been working at country orchard inspection, and at another date another man made some inspection in the boroughs. It may mean that the one inspector resigned for some justifiable reason or for some good reason took another territory, and some other person was assigned to his district for a longer or shorter period. It should not be regarded as indicating disorganization or unsystematic work, and by no means was their duplication of inspections in the same township.

While occasionally our inspectors may have made mistakes, as any one is liable to do, nearly all of them have rendered very important and highly satisfactory service to the citizens of the State, which the people realized and appreciate, as is attested by the thousands of letters which we have received upon this subject. It is only to be regretted that the appropriation was such as to limit the number of inspectors, and thus make it impossible to cover all the State during the year and one-fourth in which this inspection and demonstration work has been in progress. While some Counties have been fairly finished, others have not even been undertaken as yet, and while excellent fruit-growing districts, such as are to be found in Luzerne, Wyoming, and Lackawanna and some adjoining Counties have, unfortunately, apparently been neglected, it is our intention to make a concentrated effort at once to reach the regions that have not been inspected before this time. We propose to have every orchard in Pennsylvania inspected and every owner of infested trees instructed in methods of saving them, before this work is ended or changed. A Bill is now in the Legislature providing for increasing the scope of this work, and it is greatly desired that it

receive favorable action for the reason that it is most necessary in saving property worth thousands of times the cost of the effort by the State.

The Bill under which the present work is being conducted did not permit the funds to become available until after the first of June, 1905, and consequently that was too late to have spring (1905) demonstrations of methods of spraying for the San José Scale or other scale insects, and the campaign against such pests did not actively open until the next October, when the inspectors and demonstrators were given their special training and at once started to locate places for demonstrations in the respective districts assigned to them, and gave a number of demonstrations during the fall of 1905. During the following winter the work was almost entirely suspended, but the next spring it was resumed with increased energy, and every effort was made to give individual assistance to fruit growers and farmers who needed it. The demonstrations were given during last spring until the bursting of the fruit buds prohibited further work of this particular kind, when inspections were continued in individual orchards during the summer, and reports of these inspections were sent to the office of the Economic Zoologist, from which notifications of the findings of the inspectors were sent to the owners with publications on the subjects of the respective pests found, and suggestions of methods of treatment were given. No person was obliged to treat his trees unless he desired, excepting the nurserymen who were applicants for licenses for selling nursery stock, and who were given special attention in accordance with the methods described in our Bulletin for last month.

Last fall, as soon as the leaves were fairly off the trees, the demonstrations were again resumed, and continued until after the Holidays. In preparing for these demonstrations orchards were found that were infested with San José Scale and had trees of suitable size to spray properly with such portable apparatus as the demonstrators must carry with them. Large posters, resembling sale bills, were put up in the neighborhood of the orchard where the demonstration was to be given, and the State furnished the material, apparatus and demonstrator to do the work. On the day assigned the demonstrator was present and gave an address on the subject of the San José Scale and similar pests, particularly dwelling on the important points that the practical man must know in order to control this most serious pest of orchards, and then proceeded to make, in the presence of the assembly, the Lime-sulfur Wash by boiling seventeen pounds of Sulfur with twenty-three pounds of Lime, in water for an hour, and then straining it through our conical strainer, which is found to be the best for this purpose. It was next sprayed entirely over the trees, as far as was permitted by

the force and direction of the wind. As soon as the material was dry enough to show what spots had been missed by the first coating, which was within an hour or less, a second or retouching application was made for the purpose of showing the benefits and emphasizing the great importance of this retouching coating. Of course, where the wind was too strong to permit spraying against it, the trees could be sprayed from one side only, but the methods of making and applying the material were plainly emplified, and thousands of farmers took encouragement from this and went forward in the good work, obtaining results that are exceedingly gratifying. They are now learning that the San José Scale is a most serious pest if left untreated, but is really not to be dreaded if given attention, and that there is no need of permitting the tremendous loss of hundreds of thousands of dollars annually which this State has suffered during recent years through the presence of this and similar pests.

Many persons have watched with interest the results of the spraying by our demonstrators, and have reported to us that in some cases they were not satisfactory. This is only what can be expected when it is remembered that generally they were at a place only one-half day, and were not showing how absolutely to clean up any tree, but how to make and apply the material which would do the work if all the other conditions were favorable. Against them were the chances of unsatisfactory results due to lack of thoroughly covering the trees because the wind often permitted the spraying from one side only and the other side not being touched on that day the trees frequently not being pruned and so bushy that the interior of the tops could not properly be sprayed, and the apparatus sometimes being so light, small or temporarily defective that perfect work in coating the trees could not be done with it. Also, it should be remembered that often only a few trees were sprayed, and others adjoining them were left untreated. From these unsprayed trees the San José Scale spreads to those who were sprayed and reinfests them, and thus in time gives the appearance of poor results or imperfect work in the beginning, when if all had been equally cleaned of the pest, the latter results would appear quite different.

The thousand of persons who saw the demonstrations know that the wind was frequently so strong on the appointed day that it was entirely impossible to spray against it. Thus, the method could be shown, but good results not insured, and it is unjustice to the methods which were being illustrated to condemn them, because of the imperfection of results under those unfavorable conditions.

During the present winter attention has been given to borough inspection, and many of the cities and boroughs of the State of Pennsylvania have been and are being inspected. A printed sheet is left at each house where the San José Scale is to be found, giving an

outline of four methods of treatment, any one of which can be used with success against this pest. Results of this are very gratifying, as the persons who have a few trees in their yard generally value them, although they often know but little about the pests that assail them and the treatment that should be given.

The following is our Boro Inspection circular which is left at each place where San José Scale is found:

Directions for treating the San José Scale.

The bearer, Mr. , who is our duly appointed Inspector and Demonstrator in your region is required by law to inspect trees and shrubs for the San José Scale and other pests that may destroy them. Having inspected your trees he found thereon the San José Scale and we therefore report to you that if you wish to save your trees it is advisable for you to treat them promptly, with some material that will kill the scale but not injure the trees. You should cover the trees entirely with this material, from top to bottom. Small trees can successfully be treated by hand, using a paint brush, if the twigs all be reached to the very tips, and on all sides. To save time and be sure of getting the trees entirely covered, it is best to spray them.

We therefore recommend spraying (or thorough painting by hand) with one of the following materials:

(1). Lime-Sulfur wash, made by boiling quicklime or unslaked lime with finely powdered or ground sulfur, using 5 pounds of quicklime and 4 pounds of sulphur, in enough water to boil it for an hour, stirring it occasionally, and after boiling add enough water to make the entire amount equal to 12 gallons. Strain this well through a cloth as fine as it can be made to pass through, or better, through a fine wire netting that has at least 24 meshes to an inch. Give the infested trees and shrubs two coats of this material, at any time while the leaves are off, but the best time is just before the buds burst in the spring.

(2). Whale Oil soap, two pounds, dissolved in one gallon of water, applied as a spray or wash.

(3). The Commercial Insecticides, generally known as soluble Oils applied, in general, at twice the strength that is recommended by agents and manufacturers, or use one part of the oil to 12 parts of water, instead of 20 parts as most commercial formulæ are stated.

(4). Common Kerosene Oil or Crude petroleum, emulsified, and used not stronger than 30 per cent. for peach and plum trees and not more than 50 per cent. for apple and pear.

Avoid other material than these here mentioned, as there is danger of killing the trees or not killing the pests.

The great need in each commercial borough were the San José spraying Scale is found is the presence of a person equipped with a barrel sprayer, who will spray trees for his neighbors at a fair price. A proper charge would be from ten cents to one dollar per tree, the latter being for such trees as a full grown, very large apple tree, or pear tree of large size, which would demand ladders and very long hose for spraying, and which would really require considerable labor to cover properly. This should include the cost of material and application for a thoroughly applied primary coat and a second or retouching coating.

In New Jersey we saw a plan which appeared to suit both the operator and the tree owner, by the latter paying the former ten cents per gallon for the Lime-sulfur Wash made and applied to his trees, the operator furnishing everything and doing the work and putting the material on at a rate of ten cents per gallon for the material and services. There may be various methods of reaching the basis for a satisfactory charge for commercial spraying. If thoroughly done this will be found beneficial to both operator and tree owner.

The owner of a tree does not need to have any knowledge of the methods of making and applying an insecticide if he will watch to see that in applying the Lime-sulfur Wash the material is boiled at least an hour, and that it is sprayed entirely over the tree from the tips of all twigs to the base of the ground, so that no dark spots whatever are left upon the bark of twig, branch or trunk. It is evident that the above named price cannot include the pruning of the trees, and special arrangement and contract should be made for this. But very little of the living wood need be cut away from the tree in pruning, excepting to open the top. However, all dead and dying branches should be cut out, and especial care should be taken to prevent the interior of the tree from being too dense or filled with many twigs and small branches. In having pruning done do not make the mistake of permitting the lower branches and the longer branches to be cut away. It is best to have the head of the tree as low as possible. This is done by preserving the lower branches rather than trimming it to a ridiculous height, as is sometimes done.

Commercial Sprayers:—To aid those persons who desire to engage men with apparatus to spray for them, we here publish a small list of commercial sprayers in this State, and shall add to it as we obtain more names from time to time. Please send us names and addresses of such operators.

Bedford County.

Mr. Todder, Bedford, Pa.

Blair County.

Mr. N. A. Rhodes, Tyrone, Pa.

Clinton County.

Mr H. S. Bollinger, Lock Haven, Pa.

Cumberland County.

Mr. John Hale, New Cumberland.

Dauphin County

J. R. Snavely, Harrisburg.
F. B. Mitchel, Harrisburg.

Lancaster County.

Mr. Jacob Chambers, Lancaster, Pa.
Care of Dr. S. T. Davis.
Mr. G. W. Bellman, Lancaster, Pa.
Mr. A. F. Trout, Quarryville, Pa.
Mr. C. D. Herr, Cresswell, Pa.
Mr. G. B. O. Felty, Millersville, Pa.
Mr. J. R. Ventzer, Conestoga, Pa.
Mr. B. F. Barr, Lancaster, Pa.

Lycoming County.

Mr. Aaron Hamilton, 327 E. 3rd St., Williamsport, Pa.
Mr. John W. Wolfe, 1420 N. Market Street, Williamsport, Pa.

Monroe County.

Mr. Randall Bisbing, E. Stroudsburg, Pa.

Montgomery County.

Mr. H. E. Wohlert, Bala.
Mr. D. M. Ellis, Bridgeport, Pa.
Mr. John M. Markley, Lansdale, Pa., Lock Box 245.

Philadelphia County.

Mr. Herbert Inman, 2419 N. College Ave., Philadelphia, Pa.

Snyder County.

Mr. W. H. Bingaman, Beavertown, Pa.
Mr. J. J. Tobias, Beavertown, Pa.

York County.

John Gardner, E. King Street, York, Pa.

Demonstrations will again be given during the coming spring, both in boroughs and country orchards, and the public is invited to attend, bring samples of twigs suspected of being infested to submit them to the inspector for identification of pests present, ask questions, receive our publications, and make use of the help which this office is anxious to extend. We trust that the public will fully understand the spirit in which these words are expressed, as it is our earnest desire to make this office just as helpful and practical as it can be made, and we should feel very much discouraged if we should not daily receive an abundant correspondence upon the subjects without our profession.

We now see it is important for the work to be so enlarged as definitely to permit the study of all kinds of insects, beneficial as well as injurious, regardless of the kind of property they infest, and also to permit the study of all enemies of insects, and experiments in propagating those species which are found to be beneficial as well as in destroying injurious species. The Bill providing for this has been introduced into the State Legislature, as House Bill No. 190, and we are confident that it is important enough to justify and receive the support of the public and the help of the legislators who are so eaernestly striving to co-operate with all the factors of the State Government in giving the citizens of this Commonwealth the assistance they should have in saving their property.

REPORT BY COUNTIES.

Below we publish an outline of the results which each County shows, giving the name of the inspector or inspectors who have been at the work in said county and the number of premises inspected, and the number that have been for the San José Scale as well as some letters from different counties bearing directly upon the subject of success with the Lime-sulfur Wash, and also the names of some persons in the respective counties whom we have

found, by actual examination of their premises, to have had good results with this material.

We hope to have this work so organized before the publication of the next Monthly Bulletin that we shall be able to publish the districting of the State and the name and address of the inspector assigned to each respective district. We trust that the persons who are having trouble with pests will give these inspectors and demonstrators their assistance and co-operation, and thus permit them in turn to perform their duties in the most pleasant and effective manner to give good results for all persons concerned.

The inspectors and demonstrators are not agents for any material or apparatus, and are not permitted to make sales or advertisements of anything whatever. Any man who represents himself as our agent and who has anything to sell or is canvassing for any material or apparatus, or makes any charge for his services, apparatus or material is an impostor, and should be arrested at once and a report of the occurrence telegraphed to the office at Harrisburg. The inspectors and demonstrators are paid by the State and all our men are authorized to pay their expenses as they go, and give all possible service during a full day and full week of the time they are engaged. This they are doing in a manner that should be gratifying to those who understand the facts of the case, but if there be any evidence of any wrongdoing, shirking of duty or incompetence, this should be reported to the Department of Agriculture, in order that any abuse can be avoided, rather than tell it in the form of verbal reports from person to person and let the facts be confused. While we are trying to render the needed service to the public, we earnestly desire their help in making this as nearly perfect in results as can be made possible.

Names marked with asterisks (*) are of persons no longer on the force of Inspectors and Demonstrators.

We have the full address of each person named in this Bulletin and are able to show the evidence of each statement made and each name given. Any one will be sent upon request, but they are withheld here as a protection to the individuals.

Adams County.

Inspectors: D. C. Kauffman*, D. K. McMillan, address either Harrisburg or Gettysburg. Attendance, about 200; Inspections made, 261; number of Demonstrators 10.

Persons having good results with the Lime-Sulfur salt Wash, A. J. Raffensberger, Samuel Bream, Clarence Hoffman, John H. Heagy, M. S. Klinefelter, Wm. E. Bream, Noah Shelly, C. J. Tyson, J. M. Mickey, R 2., C. B. Kauffman, Frank Hunt, W. J. Asper, Robert Eldon.

Allegheny County.

Inspectors: James Fergus,* Hugh Fergus,* address of each Elizabeth.

Number of Demonstrations, 4; Attendance, 47; number of Inspections, 367.

Armstrong County.

Inspector, Benjamin Evans*.

Number of Demonstrations, 4; Attendance, 120; Inspections, 16; Mr A. W. Woodrow, in this county, had good results with the Lime-Sulfur-salt Wash.

Beaver County.

Inspector, James Fergus,* Elizabeth.

Number of Demonstrations, 3; Attendance, 73; number of Inspections, 10.

Bedford County.

Inspectors: W. S. Mullin*, R. F. Lee, Bedford, Pa.

Number of Demonstrations, 23; Attendance, 184; Inspections, 642.

A Bedford County Testimonial for the Lime-Sulfur-Salt Wash.

Cumberland Valley, Pa.

"Last spring I purchased a gasolene spraying outfit, and had success in working it, killing a great many San José Scale. The Bedford County Inspector inspected my orchards this fall and found many dead scale. I used Lime and Sulfur in the spring.

Yours truly,

H. F.

Other Bedford county persons having good results from the Lime-Sulfur-salt Wash: Benj. Pensyl, John Mench, Geo Zimmers, Harry F. Ripple, John S. Guyer, Geo Z. Koontz, N. P. Evans, Clayton Smith, Robert E. McNamara, A. Sellers, Samuel Henros, Geo Dibert, D. W. Lee, J. Newton Dreming, Geo. Koontz, Watson Zimmers, Emanuel Rose, Charles Jacobs, Aspy Barnet, C. C. Bortz, M. S. Bortz, Jos. M. Sonser.

Berks County.

Inspectors: E. C. Bowers, E. Petersburg, J. D. Herr, Reading (American House), and Millersville, Lancaster county, C. A. Heiss*, M. H. Snavely*.

Number of Demonstrations, 39; Attendance, 1692; Inspections 647.

Berks County Testimonials.

No. 1. Boyertown, Pa., October 25, 1904.

Where the Lime-Sulfur preparation is properly made and applied in a thorough manner it is infallible as a remedy for the San José Scale louse. As a fungicide, it has no equal. For peach leaf curl it is a specific. These are broad assertions, but I do not say I believe them to be true, but that I know them to be true. This knowledge is acquired by several years of actual practical experience in the orchard.

In the fall of 1903 had scores of trees, peach, apple, pear and plum that were not only slightly affected, but were completely encrusted. Red spots were no longer observable, but the entire inner bark was red, and the poison injected by the lice had penetrated and affected the cambium and even the wood to the depth of one-half-inch. The entire crup of fruit was so badly encrusted as to render it unsalable. These trees I expected to lose, but thought them good subjects for experiment. I applied the lime-sulphur-salt wash thoroughly, completely covering every part, going over them from every direction, with the result—every tree so treated is not only alive, but the red has disappeared from the surface, the cambium is restored to perfect health and performs its function as nature requires. The foliage on these trees is the richest green of any in the orchard. New wood from six to eighteen inches has been added, and a heavy crop of the most perfect apples, smooth, clean and highly colored, rich in flavor, was borne by them this seeason, and not a living scale can be found on either the fruit or twig. Is this not evidence of the effectiveness of the wash?

Every case of failure to not only hold in check, but to fully exterminate this pest, is attributable to one or all of three causes—

1. Poor material.
2. Improperly manipulated or prepared.
3. Imperfectly applied.

Hoping that this conveys my views in regard to this once dreaded, but no longer feared pest, I am,

Very truly yours,

J. H. FUNK,

Fruit Specialist and Promologist State Board of Agriculture.

No. 2.

"In reply to your leter, I would say that I used the lime-sulphur-salt wash for the San José Scale according to your formula, spraying the second week of April, 1906. I did not use it on large trees, but experimented on young trees, peach, apple, plum, etc., and as

far as I can discover obtained excellent results. The trees which were sprayed are thrifty and clean, while those were not sprayed are in a bad condition. I expect to spray all my trees this spring.

I used the materials in the following proportions: Twenty-two pounds of lime, seventeen pounds of sulphur, and one quart of salt. I applied the mixture with a hand sprayer, using a white wash brush for the trunks. As I said before, the trees to which the mixture was aplied are free from insects and are thriving.

I am receiving your Monthly Bulletins and find them to be a source of much important information."

Very truly yours,

A. R. LEINBACH.

Other Berks County persons having good results from the lime-sulphur-salt Wash: W. P. High, Oliver Shearer, Franklin Shirk, Solomon Shearer, Dr. Reuben D. Wenrick, Charles Dunkle, A. N. Shearer.

Blair County.

Inspector, D. K. McMillan, Harrisburg or Gettysburg, Pa.:

Number of Demonstrations, 4; Attendance, 120; Inspections, 539;

Bradford County.

Inspector, W. B. Packard.:

Number of Demonstrations, 5; Attendance, 125; Inspections, 308.

Bucks County.

Inspector, J. R. Davis.:

Number of Demonstrations, 17; Attendance, 340; Inspections, 27.

Testimonial:

Dear Sir: In reply to yours of December 27th, will say that the past season I used about one hundred and fifty pounds of lime sulfer and salt, and it seems to give good satisfaction. I boil the wash with steam for about one hour, and then put it on the trees. However, when first applied, it did not appear to show as well as the preparation which I used in the spring of 1905, which was not boiled so long. The only objection was that it did not make the trees so white.

Very truly ours,

C. H. WATSON,

(Note.—The difference in color was no doubt due to the fact that calcium lime was used the first time and magnesium line was used the second time. See p. 269.—H. A. S.)

Butler County.

Inspector, J. W. Cox, New Wilmington, Pa.:
Number of Inspections, 105.

Testimonial:

Dear Sir: I received your letter sometime ago inquiring of my results of the oyster shell scale remedy. About the second week I made a preparation of lime and sulfur and put it on with a white wash brush. I put one-fifth sulfur and four-fifths lime, mixed with water. Wherever I washed the tree it killed the insects, and where I did not get it on the ends of the small limbs the insects are still there. I think if properly applied it will be a success.

I do not receive your buletins but would be obliged to you if you would send them.

Yours truly,

G. F. MILLER,

Cambria County.

Inspector, Benjamin Evans.:

Number of Demonstrations, 5; Attendance, 165; Inspections, 162.

Cambria County persons having good results with the lime-sulfur-salt wash: Miss J. M. Laughlin, Simon Vaught.

Carbon County.

Inspector, P. R. Boltz, Lebanon.

Number of Demonstrations, 4; Attendance, 104; Inspections, 49.

Testimonial:

Prof. H. A. Surface, Harrisburg, Pa.:

Dear Sir: I used the lime-sulfur-salt wash and do, indeed, feel gratified with the results. I boil it in an iron kettle, using twenty pounds of lime, ten pounds of sulfur and seven and one-half pounds of salt to thirty gallons of water. In preparing it I also use another large vessel to heat the water and when the first preparation is ready to apply, I put it in the sprayer and immediately put on the second, using the hot water to slake the lime and to fill with water after boiling. In this way, by having some one to attend to the fire, the second preparation is ready by the time we have the first applied.

After having tried several other solutions, without success, I first used the lime-sulfur-salt wash in March, 1903. In the following fall and winter I pruned the orchards well, and again sprayed in March, 1904. When the leaves began to make the spring growth

I again pruned, and cut out all the dead and badly infested wood, and burned it. This treatment has been given to an apple orchard planted in 1894, consisting of about twenty- eight trees, and a peach orchard in 1899, consisting of 293 trees.

While there is a good deal of labor connected therewith, the expense is small. I believe it is the best insecticide we can use, also the best preparation for peachleaf curl that I have ever used. Some trees planted at odds away from the orchard and not sprayed were badly infested with curl, while in the orchard that was no sign of it. In conclusion, will say I have been well paid for my labor, and do firmly hold that by giving our orchards real practical attention we are able to keep the San José Scale where it will not do as much harm, I am,

Very truly yours,

C. N. H.

Theoretically the same amount of lime should be used as of sulfur, because they combine in equal proportions, but practically a slight quantity of lime is needed in excess of sulfur; but it need not be twice as much.

Note how the writer was able to keep his barrel sprayer going by using only two iron kettles. He announces decidedly successful results during two years' operations. What he says of the actual expense is true in every regard. The mere cost of treating the San José Scale, excepting for the item of labor, is very small, indeed. Note his results with peach leaf-curl, which are as stated elsewhere in this Bulletin. Such letters are very encouraging.—H. A. S.

Other Carbon County persons having good results with the lime-sulfur-salt wash: Henry A. Graver, D. N. Rehr, H. N. Graeber, H. N. Miller.

Center County.

Inspectors: C. A. Heiss*, A. B. Lehman*, C. C. Hess*.

Number of Demonstrations, 11; Attendance, 374; Inspections, 169.

The following Center County persons had good results with the lime-sulfur wash: W. H. Dornblaser, Henry Marks, Geo. W. Tressler, F. S. Dunham.

Chester County.

Inspectors, H. H. Dutton*, J. R. Davis*, E. L. Loux, Souderton.

Number of Demonstrations, 21; Attendance, 312; Inspections, 1128.

Testimonial:

Chas. Sheidle, Phoenixville, Pa., sprayed with the lime-sulfur wash in March, 1905, and March 1906, with result that now there is no scale, although he says the trees were badly infested a year ago, and he knows the scale. While these trees are cleaned up at present, he neverthelss says that he will spray again in March, 1907, as a precautionary measure."

E. L. LOUX, Inspector.

No. 1

Prof. H. A. Surface, Harrisburg, Pa.:

My Dear Sir: I feel that the farmers appreciate your efforts to aid them. The only trouble seems to be that imperfect spraying done by some fruit growers has impressed people that it is impossible to control Scale. I am trying to convince them that thorough work is necessary.

In relation to poor results obtained by certain persons in using lime-sulfur-wash, as reported to me, allow me to say that in every instance I was able to find definite reasons for such failure to obtain good results. There is no question but that the lime-sulfur compound, properly or thoroughly applied, will do the work.

Very truly yours,

E. L. LOUX, Inspector.

No. 2.

Prof. H. A. Surface, Harrisburg, Pa.:

Dear Sir: In reply to your favor of the 19th inst., I may state that the trees have been infested with the scale for two years, in which time one tree has died. The scale was causing a reduction in the yield and would have resulted in the entire destruction of the orchard if they had not been treated at that time. The only treatment that they received was the lime-sulfur wash, which I applied for the first time in the spring of 1905 as an experiment. In the spring of 1906, I applied the first and only coat which they have received, with the result, that the trees are in fairly good condition now.

Notwithstanding the loss of several hundred baskets of peaches by the wet weather, I sold 1107 baskets, receiving $1,024. At present I have two and one-half acres of peaches in bearing. From my experience, I think the lime-sulfur wash acts as a fungicide as well as destroying the scale. It is the best solution that I know.

Hoping to have the pleasure of meeting you some time, I am,

Yours respectfully,

G. W. REFSNYDER.

(To be Continued Next Month.)

H. A. S.

SPECIMENS RECEIVED DURING DECEMBER, 1906.

To voluntary contributors we are indebted for the following specimens received during December, 1906, supporting our work and used in studies.

Number.	Specimen—Insects.	Date—December, 1906.	Name and Address.
3353	Work of Moth Larvæ,	4	Miss M. L. Dock, West Fayetteville.
3357	(e) Bird Lice from Goshawk,	4	J. B. Richard, Barto.
3360	Tropical Butterfly,	6	C. Anderson, Harrisburg.
3363	Collection of Mounted Insects (15 spp.),	6	B. G. VanHousen, Williamsport.
3369	Scurfy Scale,	10	C. B. Sterner, Brodbecks.
3371	Angoumois Grain Moth,	11	D. and A. Luckenbach, Bethlehem.
3372	(b) Oyster-shell Scale,	13	J. B. Richard, Barto.
3373	Cecropia Cocoon,	12	P. Z. Zerger, Chambersburg.
3377	Bag Worms,	12	W. I. Horner, Fairfield.
3378	Grain-infesting Insects (6 spp.),	12	J. P. Couch, Carnegie.
3380	(a) Scurfy Scale, (b) Oyster-shell Scale,	12	F. Bertolette, Mauch Chunk.
3373	Oyster-shell Scale,	14	B. Armstrong, Munderf.
3384	(a) Oyster-shell Scale, (b) Scurfy Scale, (c) Rose Scale,	14	L. S. Foulk, Schuyler.
3385	Giant Water Bug (B. americana),	15	J. Kerstetter, Liverpool.
3388	San José Scale,	15	Dr. B. L. Ryder, Chambersburg.
3390	San José Scale,	17	F. Bennett, Pomeroy.
3392	Spring Canker Worm (P. vernata),	17	Prof. M. V. Slingerland, Albion, N. Y.
3394	San José Scale,	18	W. O. Freytag, Philadelphia.
3396	Moth Pupæ,	18	J. J. Brown, Athens.
3397	Rice Weevil (C. oryzae),	18	F. T. Chambers, Bristol.
3398	Tussock Moth Eggs,	18	Miss N. Brightbill, Marsh Run.
3401	Green-house Scale (C. sonidum),	19	H. F. Walton, Philadelphia.
3403	White Fly,	19	Mrs. D. S. Hower, Milton.
3406	Oyster-shell Scale,	21	J. Mosier, Saegertown.
3407	Oyster-shell Scale,	21	A. B. Kilbourne, West Pike.
3408	Lecanium on Lemon,	21	C. E. Ross, Sunbury.
3411	Moth Larvæ and Pupæ,	26	J. J. Brown, Athens.
3412	Rice Weevil,	26	F. T. Chambers, Bristol.
3413	San José Scale,	26	C. Bittenbender, Bloomsburg.
3414	Oyster-shell Scale,	27	D. A. Sawdey, Erie.
3415	Scurfy Scale,	28	T. W. Hemerly, Steinsville.
3417	Bird Lice on Goshawk,	28	J. E. Confer, Yarnell.
3419	Scurfy Scale,	29	F. S. Frellmick, Ulster.
3420	(a) Eggs of Tussock Moth, (b) Moth Pupæ,	29	M. H. Pfleager, Mechanicsburg.
3424	Scurfy Scale,	31	E. P. Miller, Altoona.
3425	Currant Flies,	31	J. S. Snelbaker, Dover.
3426	(a) Scurfy Scale,	31	J. F. Young, Ellwood City.
3427	Scurfy Scale,	31	H. J. Snyder, New Ringgold.
	Invertebrates not Insects.		
3345	Cysticerus stage of Rabbit Tapeworms,	1	R. W. Wehrle, Indiana.
3391	(b) Mites,	17	R. M. Johnson, McVeytown.
3395	Millipedes,	18	C. M. Weaver, Ronks.
3407	Scale-eating Mite (H. malus),	21	A. B. Kilbourne, West Pike.
3428	(b) Mites,	31	J. F. Young, Ellwood City.
	Fishes, Batrachians and Reptiles.		
3343	(a) Sculptured Turtles,	1	R. W. Wehrle, Indiana.
3350	3 Leopard Frogs (R. pipiens),	3	D. Carruthers, Harrisburg.
3352	(a) 2 Common Garter Snakes, (b) Common Water Snake, (c) 2 House Snakes,		Dr. H. S. Pratt, Haverford.
3357	(d) 4 Blue Racers,	4	J. B. Richard, Barto.
3358	Sculptured Turtle,	4	W. J. Blatt, Huntingdon.
3374	Grass Snake,	12	H. Mulford, Mont Alto.
3375	Swift (S. undulatus),	13	J. McNeal, Mont Alto.
3376	Turtle Eggs,	12	Dr. I. M. Weills, Harrisburg.
3386	Newt (D. viridescens),	15	T. Oxford, Bangor.
3387	2 Land Salamanders (P. cinereus),	18	W. C. Dickson, Wayne
3393	Hellbender,	18	R. W. Wehrle, Indian

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REPORTS OF PERSONAL EXPERIMENTS.

Experiments for the Cabbage Root Worm (Phorbia brassicae).

The Cabbage Root Worm or Cabbage Root Maggot is one of the very destructive pests in this State. The production of Cabbage, especially of the early varieties, and of Radishes has become so difficult, owing to the ravages of this pest, that many growers are in despair and some have abandoned their efforts to produce these crops.

Life History: The Cabbage Root Worm or Cabbage Root Maggot is the larva of a fly about the size of the House-fly and somewhat similar in appearance. This fly deposits its eggs in the soil close to the plants of Cabbage, Cauliflower, Kale, Kohl rabi, Turnip, Radish, Mustard and some other plants. These eggs hatch in the course of some days, perhaps about ten, and the young "worms" or larvae pass down the stalks to the roots or bore into the flesh of the roots and feed for about three weeks, when they become full-grown and pupate or change to elongate brown pupae in which they remain quiet during a week or two in June, when they emerge as two-winged flies, and again seek the roots of their food plants to deposit their eggs for the second brood. It may be that there is a third brood in the warmer or lower parts of this State, but in most parts of Pennsylvania this insect has two broods per year, and the young of the second brood develop the pupal or resting stage and remain in the soil during the latter part of the summer and during the fall and winter, and the winged fly comes forth during the latter part of April.

Our observations show that they commence to lay eggs about the first of May and the larvae are feeding about the second week of May and until the end of that month. The first brood of these insects pupate about the first of June and a few days later when we found large numbers of the pupae in the ground close to the surface and within an inch or two from the Radish or Cabbage or other plant which they attacked. The most of them were about an inch below the surface, although some were found at a depth of two inches and others not more than one-half inch in the ground. The pupa is about seven-thirty-seconds of an inch in length and three-thirty-seconds of an inch in diameter. From these the first adults emerged on June 8th in the field, but as early as June 5th in our cages.

On June 4th about one hundred specimens were placed in our breeding cages, and Mr. H. O. Marsh, who has them in charge,

records that one emerged on the fifth, another on the sixth, the same number on the seventh, two on the eighth, and increased in numbers until the eleventh and twelfth, when the maximum number of adults was obtained after which they decreased in numbers until the eighteenth, when the last fly came forth.

From specimens No. 6444, in our Collection, collected near Harrisburg, June second, we obtained a very peculiar and interesting fact in establishing the proof of a beetle as an internal parasite of this fly. The beetle is known as the Rove Beetle, belonging to the Family Staphylinidae, scientific name Aleochara nitida.

The fly pupae were uninjured and apparently all in the same condition when placed in the breeding cage on June 2nd. All the flies emerged on or before the 18th of June. However, on the 20th, eighteen Staphylinid beetles emerged from as many pupal shells, between nine A. M. and four P. M. On the next day about twenty of these parasitic beetles also came from as many separate shells of the fly pupae, and they continued to emerge until the twenty-fifth, when the last of them appeared. It will be noted that the last of the flies had developed at least two days before any of the parasitic beetles appeared. It is so important that this friend of the trucker be recognized that we shall publish a plate showing it in its natural size and also greatly enlarged.

Other enemies of the Cabbage Root are known to be small Carabid Beetles or Ground Beetles, which Mr. McMillan has collected feeding upon them, Cynip parasites, which we have bred from a Phoria larva which was feeding on Turnip, and other insects feeding upon them mentioneed by a few writers on the subject. We have frequently observed the egg shells of what were apparently the eggs of this fly lying close to plants and apparently destroyed by some insect. On May fourteenth Red Mites in numbers were collected at the base of Cabbage plants and were suspected of being the destroyers of the eggs of this fly.

Owing to the importance of this subject we undertook in 1905 a series of experiments, the results of which were partially outlined in Vol. III, No. 4, page 116. Further experiments were conducted in 1906 with excellent and encouraging results, and we now see the important points that are to be determined by further and perhaps final experiments during the coming spring season. We take this occasion to publish the results of the two general series of experiments that have been performed by this office during the previous seasons.

I. Experiments for the Destruction of the Eggs or Very Young Larvae of the Cabbage Root Worm.

These experiments which were outlined in detail by the Economic Zoologist were performed by Mr. D. K. McMillan on the truck farm

of Mr. George Houser, near Harrisburg, Pa. Mr. McMillan was assisted by Mr. Houser and his employees.

May 1st to 5th, 1906. The fields for the experiments were near those that were badly infested last year, and the soil was lose and sandy above but well cultivated with moist ground beneath. The weather was fair, warm and breezy without rain.

At the time of the first application on about May 1st the adult flies were commencing to lay eggs, and in fact these eggs were found in abundance about most of the plants treated. The chief materials that were used were Carbolic Emulsion and Kerosene Emulsion. The Carbolic Emulsion was made according to the following formula: One pint of Carbolic Acid, one pound of Brown Soap or Whale Oil Soap, stirred well together and then made into an emulsion with one gallon of soft water. For use this was diluted with hard water in proportions varying from one of the Carbolic Emulsion to ten of water, which was the strongest tried, to one of the emulsion to thirty-five of water, the most dilute. Wherever liquids were used they were applied by hand with a dipper holding about one-half pint, and used in treating two plants, or in other words about one-fourth pint of the dilute emulsion was used for each plant.

In all cases where not otherwise mentioned the Cabbage was the plant treated, although several other cruciferous plants, both cultivated and uncultivated were growing in the vicinity, and were also infested with the Cabbage Root Worm. The chief experiments were performed in a field of thirty-four rows, containing about one hundred and fifteen plants per row, and with nearly all the materials tried two rows were selected for the application. The plants had been set in the latter part of March and were about six inches high. The effort was to discover the material that would destroy the pest without injury to the cultivated plants, and to do this we found it necessary to try several strengths of the materials, in order to determine the weakest that would kill the insects and the strongest that the plants would stand without severe injury. In the case of the Carbolic Emulsion this was ascertained very plainly, as will be seen from the table below. All eggs were killed by the strongest solution of Carbolic Emulsion viz., one part to ten of water, but with this and the next the leaves were burned more or less, but not seriously. The other strengths showed no injury whatever to the plants, but the weakest emulsion or one to thirty-five water left a few of the eggs, showing that it was not strong enough to have the desired results. It should also be recorded that very few eggs were laid after the treatment in the rows both with Carbolic and Kerosene Emulsion, and thus these materials are preventives as well as remedies. Within a few days after the application the eggs were plainly discolored, showing that the life within them had been destroyed.

Where care was taken to pour the liquid to the side of the stalk and not on the leaves there was no injury by any of the materials. Thus it also shows how to use the strongest Kerosene Emulsion with safety as far as injury to the plant was concerned, but it must be kept off the leaves. Our conclusions from the results with the Carbolic Emulsion are that the eggs and very young larvae are easily destroyed by applying about one-quarter pint of Carbolic Emulsion made according to the above formula and diluting with from fifteen to thirty parts of water, poured down the side of the stalks, but not on the leaves.

The Kerosene Emulsion: Kerosene Emulsion was also used on rows fifteen to twenty-eight inclusive, making the Kerosene Emulsion by the regular formula of one-half pound Hard Soap or Whale Oil Soap, dissolved in one gallon of warm water, and stirring or agitating with two gallons of Kerosene until a complete emulsion is formed. This is the stock solution, which is kept to be diluted with water when used. It is not necessary to use warm water nor soft water in diluting, although in making the stock for both emulsions better results are obtained by using warm soft water.

As is shown in the table below the standard stock solution of Kerosene Emulsion was diluted with various proportions of water, ranging from three to twenty. With the strongest solution or one part of the stock emulsion to three of water, there was injury to the Cabbage leaves in some places where the liquid was poured on them, but where it did not touch the leaves no injury was done, and the eggs and young larvae were killed in nearly all cases. With the most dilute emulsion the eggs were mostly killed, but not all, and there was no injury whatever to the leaves of the plants. We found the intermediate proportion or one part of stock emulsion to eight parts of water to be the best that we can recommend, as it killed practically all the eggs and larvae with no apparent injury to the plants. Where any liquid is used it washes the eggs away from the plant in many cases, and by this action helps to give protection, although the chief value was in destroying the life that was in the egg. The stronger liquids of both kinds acted as repellants, although eggs were laid in many of the plants about ten days after the treatment.

On rows twenty-nine to thirty we used a mixture of prepared Lime, Salt and Alum and perhaps other ingredients ground together and recommended for the Cabbage Root Maggot. This and the other dry materials were applied by hand around the stalk on the surface of the ground, merely sprinkling about a handful around the base of each stalk. As to the results of these powders we can say that although a few of the larvae were found present two weeks after the treatment, the plants were not seriously injured by the

Maggots and certainly showed much better condition than those in the check rows or untreated rows.

Dry Slaked Lime was also tried abundantly, about one ounce thrown about the base of each plant or stalk by hand, with the result that most of the larvae or eggs were destroyed, but there were a few larvae found two weeks afterward, although the plants were not seriously injured by the pests.

Common Salt, one-half ounce at the base of each stalk was tried with the results mentioned above for the other powdered materials. Many of the plants had just a few larvae present on each but survived the attacks very well, and perhaps were considerably aided by the application of the Salt. Nitrate of Soda was used in the same proportion and, in general, we ascertain good results.

Rows thirteen and fourteen, near the middle of the field were left as check rows or untreated rows, and were found to be so badly infested that the plants were useless and in fact were later destroyed by the pests.

In another field four rows of Cabbage plants, averaging about one hundred and twenty per row, were treated experimentally on May 5th with other materials that gave interesting results. Among the methods of treatment we tried tarred paper pads, cut by a punch made for the purpose and to be used like a gunwad, cutting and placing the pads around the stalks in such a way that the plant extended through the centre of each pad, when it was placed around the stalk, and pressed firmly down to the ground. All the plants in this field had been planted less than two weeks from the seed bed and were in good condition for experimentation. We found that the paper disks were easily disarranged by the cultivator and covered with earth and were not so effective as when left undisturbed or uncovered, and we really do not think this a practical means of preventing this pest, excepting in small gardens or a small patch in a garden or where you are growing Cabbage and Cauliflower for your own use, and may have only a few hundred plants to treat. It is a tedious operation to apply these pads and requires care and work to keep them in the proper position through the egg-laying season. We tried disks of thick brown paper, but that curled at the edges and otherwise got out of shape without giving satisfactory results, and disks of paste board and other materials were soaked to pulp by water. Tarred paper, such as is used for lining or sometimes for roofing, gave the best results as a material for making such disks. Sheets of paper can be cut with scissors that will serve the purpose very well, and we have used them in our own garden successfully after having made them in this way. The chief objections to the paper disks or pads is the time it requires to make them, put them

in place and keep them in position, and the great care required to avoid covering them by the cultivator.

Tobacco Dust was applied around plants in one of these rows using a small handful on the ground around the base of each plant, with results about the same as those from the use of the Tarred Paper. Some of the plants were kept entirely free from injury and others were slightly infested, while no injury to the plants came from either treatment.

Kerosene Emulsion, one part of the Stock solution to fifteen parts of water, was applied to another row in this field, using a water can without the sprinkler attached, and applying about one quarter of a pint to each plant. The eggs were killed or washed away, and the young larvae were practically killed with no injury to the plants. The same can be said of the Carbolic Emulsion, one part of the Stock Solution to twenty-five parts of water, as good results were obtained in destroying the pests without injury to the vegetation treated. We soon found that the liquid was easily applied and that three applications during the first two weeks of May kept the plants free from injury.

3. Experiments for Destroying the Well-Grown Cabbage Root Maggot.

These experiments were performed on May 24th on plants several weeks of age, in soil that was loose, sandy and dry. The weather was warm and fair, with no rain for more than a week after the applications were made. Five kinds of material were used, at two different strengths for each, on about fifty plants in each row. Among these materials and the results obtained from them are the following: Table Salt, one teaspoonful to each plant in one row, and one tablespoonful to each plant in another, applied by hand and at the base of each stalk. This did not injure the plant neither did it kill the insect. The Salt remained undissolved, and it is probable that if the soil had been more moist or if rain had come to dissolve it, the beneficial results would have been more marked.

Nitrate of Soda, one teaspoonful, and also one tablespoonful was used in the same way and with the same results as the Salt, and doubtless the explanation as to the lack of moisture applies here as well.

Carbon Bisulphide was injected into the soil at the roots of the plants. This was done by injecting a pipette or glass medical tube in the soil beside the stock in such a way as to reach the roots, and the ground was thrown up and pressed firmly around the plant after the injection. The stalk itself was not touched by the material and no injury whatever was seen to the plants by the use of the Carbon Bisulphide, although one hundred per cent. or all of the

insects were found dead. This is a safe and easy treatment, and this means that it is to be highly recommended and will bring good results to our cabbage growers if they will provide themselves with the means of applying it. The only precaution is to keep fire away from it as the fumes are explosive as those of Gasolene or Benzine.

Carbolic Emulsion was also applied in this field, one-half pint to each plant or a mixture of one part of the Stock Emulsion to twenty-five or thirty parts of water, pouring it into the ground around the plant, with no injury to the plants and with entirely unsatisfactory results in killing the pests. With the former application not five per cent. were dead, and with the latter not over two per cent. The poor results of this emulsion in this field are apparently due to the low percentages used or the great proportions of dilution and also the very dry and loose condition of the soil.

Gasolene was applied by injection into the soil, using about one tablespoonful for each plant on one row, and one teaspoonful for each plant on the other row. This material killed all of the pests, but unfortunately also destroyed the plants. It may be possible that a method of injecting Gasolene beneath the roots so as to avoid contact with them may give satisfactory results in destroying the pests without injuring the plants, and this demands further attention from us in the spring.

From this experiment and from a later study of results we learn that it is not at all advisable to permit the plants to go without treatment until the larvae are grown, or as late as the last week of May. Some of the plants were so badly injured by the worms at the time of treatment that they died afterward, while others threw out new roots above the place of injury and recovered, but as was to be expected, did not make as good growth as those that had not previously been injured. Evidently much of the treatment of these plants was too late to be noticeable in benefitting the plants and in promoting their growth, although the results in destroying the insects were as shown below:

Wire Worms also Destroyed: In the middle of the large field where the first experiments had been performed a sod had grown the previous year and as a consequence Wire Worms were present in considerable numbers. At the time the Carbolic Emulsion and Kerosene Emulsion were applied it was not known that these pests were present, although when an examination was made about a week later a considerable number of them were found dead at the surface of the ground and were lying near the plants, dead. This was especially the case where a stronger Kerosene Emulsion was used. Thus this can be recommended for Wire Worms where a small area is to be treated. It was to be noted that where the Emulsions were not used some plants were injured by the Wire Worms probably

more than by Root Maggots. Consequently, the discovery of a remedy for the two pests, which can be applied at the same time is worthy of note. On May 7th and 8th the young cabbage plants grown from seed and growing closely in rows were treated with Carbolic Emulsion, one to tweny-six along the side of the plants. Of these young plants there were about fourteen rows, about fifty feet long. About ten gallons of the dilute Carbolic Emulsion were used at each application, and two applications were made at an interval of a few days. Some of the plants were burned by the Carbolic Acid which separated from the Solution, but only a small percentage were so injured. This was only where it was poured directly into the heart of the plant. The flies were laying their eggs when the treatment was begun and nearly all such eggs were destroyed. No injury by maggots was noted, and the owner was pleased with the results as he was depending upon these particular plants for later planting in his field. Last year he lost nearly all of the growing plants, which were grown under similar conditions but without treatment, while this year they were saved by this simple treatment.

Another planting of cabbage seeds was coming through the ground at this time, and the highest plants were not more than an inch above the ground. These were treated with the Carbolic Emulsion, one part to twenty-five of water, which was applied with a watering can with the sprinkler removed. Two applications were given them and the plants were not attacked nor injured later by Maggots, excepting an occasionally infested plant at a much later period. The liquid was poured directly on the rows in the case of these young plants, but it did not seem to injure them in the least. If the liquid is to come into contact with the plants it is necessary to skim off the brown scum, which is the separated Carbolic Acid, which may rise to the surface of the Emulsion.

Food Plants of the Cabbage Root Maggot.

The Cabbage Root Maggot is known to infest a number of cruciferous plants, both cultivated and uncultivated. It is important for the husbandman to know this fact and bear it in mind in suppressing this pest. If they be held well in check on the cultivated plants, and the weeds which they infest be destroyed, they will certainly not be so numerous.

Cauliflower is more seriously injured by this pest than is Cabbage in adjoining fields. This is probably because it is a more delicate plant. The treatment, however, is practically the same as for the pest in Cabbage.

The Radish is more readily infested than Cabbage, and for this

reason some authors recommed sowing Raddish seed along the Cabbage rows. We hope to try this as an experiment next season and report results. The Radish should be sowed at least two weeks before the Cabbage is to be planted in the field. However, it is important to pull or bury or burn or feed all of the infested Radish roots when they become badly attacked and not to permit the flies to mature in them.

Kale on several truck farms was examined about the middle of May, and numerous larvae were found working beside and within the roots, but many of the plants that were shooting into seed were not injured. It is probable that this was because that had such strong growth as to withstand the effects of the pest. It is the custom of truckers to plow under the Kale about May 30th, and this of course, is proper treatment for all trap crops when the pests have not completed their growing season or stage, but when they are grown it is wrong for it keeps them in the soil where they are able to do further injury when they mature. It is better to pull and burn them then.

The Turnip is likewise attacked by this pest, and for the Turnip we have not only the Cabbage Root Maggot (Phorbi brassicae), but also the Cynip parasite of the pest.

Wild Mustard was found to be badly infested with the Cabbage Root Maggot about May 15th, and the lesson from this is to destroy all the Wild Mustard plants by pulling them about the third week of May. At this time the flies of the first brood have mostly laid their eggs, and their larvae are not sufficiently developed to transform without further feeding.

The Cabbage Root Maggot Infesting Radish: There appears to be no distinct species of the Radish Root Maggot found here, as the fly larva which we have found attacking the Radish is certainly the same species that is injurious to the Cabbage, Cauliflower and certain other cruciferous plants, and is commonly known as the Cabbage Root Maggot or Cabbage Root Worm, identified as Phorbi brassicae. It has been published and is generally believed that the Radish Root Worm is a different species of insect, but we have reason to agree with Prof. Slingerland of the Cornell Experiment Station, who has said in his publications that is appears to be identical.

At the time the experiments were being conducted on the larger cabbage field about May 1st, a few remedies were tried on a Radish patch located about two hundred feet distant. These Radishes were sown early in April, and were grown well at this time. By sweeping the leaves of the Radish plants with a net on April 25th a great many of the adult or mature flies were captured and on May 30th they were present upon the Radishes as well as upon the Cabbage and were laying eggs on both plants.

A preparation consisting of Lime, Salt and Alum mixed together was thrown about on the cabbage plants and dry Lime was also applied as well as Carbolic Emulsion and Kerosene Emulsion, the two liquids being applied with a sprinkling can to the plats about twelve feet square, using one of the Carbolic to twenty of water and one of the Kerosene to ten of water. The whole patch was badly infested by May 15th, and few of the Radishes were fit for the market. The Photograph of Plate .... was taken from the plants in this field and shows how badly they were affected. Those treated by the Emulsions were less infested than the rest, but it appears that the remedies were not applied in time to have the desired results. It should be remembered that this pest often feeds inside of the fleshy root or stalk, and in attacking the Radish and Turnip it nearly always feeds inside the root, while with the Cabbage it is only occasionally on the inside and generally feeds on the outside or around the small root. The treatment with Lime, etc., sown broadcast gave unsatisfactory results, being in both cases too thinly applied and probably also to late. However, Lime or Tobacco are to be recommended, and they should be applied close to the plants and before the eggs are laid so as to prevent the egg-laying.

The results on the young Cabbage plants mentioned above indicate that Radish plants can be grown in narrow rows and protected by a few applications of Emulsions if taken in time before the eggs hatch and applied at intervals of perhaps about a week each. This will not be found expensive or troublesome after one tries it, and we have reason to think it will give good results on the Radish plants if taken early as it did upon the young Cabbage plants.

Practical Measures.

Preventives.

(1) Preventives of plant trap crops, such as Radishes or Kale are necessary two weeks before the time when the Cabbage is to be put into the field. The flies will lay their eggs in these and after the larvae are commencing to develop well in the trap crops, these should be burned or feed.

(2) Destroy cruciferous weeds and all other plants that are infested about the last week of May, when the young larvae are in their roots but before the pests are developed.

(3) Destroy all stumps and roots or plants in the fields by burying or burning rather than leaving them to carry the insects and protect them through the summer and winter.

(4) Plant the later crops after the first of June as it is known that the late Cabbage Plants and others are not generally destroyed nor even seriously injured by the Cabbage Root Maggot.

(5) Use such fertilizers as will affect the plants and inject vigor into them, and help them to overcome the fatal attacks of such enemies.

(6) Cultivate well to promote growth, conserve moisture and otherwise stimulate the plants.

(7) Practice rotation of crops, planting cultivated plants of this Family as far as possible from a field where the Root Worms were present last year and in the infested fields grow plants that do not belong to the Mustard Family or Cruciferae.

(8) Recognize and preserve the enemies of such pests.

Remedies for the Cabbage Root Worm.

Our experiments have shown that the Cabbage Root Maggot or Worm is destroyed without great trouble or expense by pouring a quarter of a pint of Carbolic Acid Emulsion at the strength of one part of the Stock Emulsion to fifteen to thirty parts of water around the base of each plant during the first week of May, and repeating this every week or ten days for a month. Also Kerosene Emulsion one part Stock Emulsion to about eight parts of water will likewise give excellent results in destroying the eggs and young larvae. Also Slaked Lime or Tobacco Dust as well as pads or disks of tarred paper placed around the plants will prevent the laying of the eggs at such places and keep the plants in good condition. Another excellent remedy consisting of Carbon Bisulphide injected in the small quantity of a teaspoonful or less around the roots of the plant is to be recommended. Of course, it is better to use preventives, such as Tobacco Dust, Slaked Lime or Tarred Paper Disks and keep out the pests from the plants instead of waiting until they appear and being forced to kill them by the Emulsions or Carbon Bisulphide. However, there are now enough remedies to justify us in saying this pest is not beyond control, and no one should lose his crop on account of its presence.

Prof. Washburn of Minnesota has had excellent results in using glue and bran, or glue and sawdust put in a little heap around the stalk and thus preventing the laying of eggs.

Summary of above Experiments: Experiments with Remedies for the Cabbage Root Maggot (Phorbi brassicae) performed at George Houser's Truck Farm near Harrisburg, Pennsylvania, by D. K. McMillan assisted by George W. Houser and employees. Soil, loose, sandy, dry above but located on eastern side of trolley line near ground badly infested last year.

May 1st, 2nd and 3rd, '06. Eggs laid on nearly every plant

Weather fair and warm and breezy at times.

Rows. No.	Kinds of Remedy.	Formula or Percentage.	Number Treated.	Age and Size.	Effects on Pests.	Effects on Plants.
1 & 2	Carbolic Emulsion, regular formula.	1 to 10,	115 per row,	6 in.,	All eggs killed,	Burned leaves.
3 & 4	Carbolic Emulsion, regular formula.	1 to 15,	115 per row,	6 in.,	All eggs killed,	Burned leaves.
5 & 6	Carbolic Emulsion, regular formula.	1 to 20,	115 per row,	6 in.,	Good eggs killed.	
7 & 8	Carbolic Emulsion, regular formula.	1 to 25,	115 per row,	6 in.,	Good eggs killed.	
9 & 10	Carbolic Emulsion, regular formula.	1 to 30,	115 per row,	6 in.,	Good eggs killed.	
11 & 12	Carbolic Emulsion, regular formula.	1 to 35,	115 per row,	6 in.,	A few living.	
13 & 14	Check,				Badly infested by P. brassicæ and wire-worms.	
15 & 16	Kerosene Emulsion,	1 to 3,			Eggs killed in most cases,	Injured where wet leaves.
17 & 18	Kerosene Emulsion,	1 to 4,			Eggs killed in most cases,	Injured where wet leaves.
19 & 20	Kerosene Emulsion,	1 to 5,			Eggs killed in most cases,	No injury.
21 & 22	Kerosene Emulsion,	1 to 8,			Eggs killed in most cases,	No injury.
23 & 24	Kerosene Emulsion,	1 to 10,			Eggs killed in most cases,	No injury.
25 & 26	Kerosene Emulsion,				Eggs mostly killed,	No injury.
27 & 28	Kerosene Emulsion,				A few larvæ found a few weeks after treatment.	No injury.
29 & 30	Prepared lime mixture,	About 1 oz.,			A few larvæ found a few weeks after treatment.	No injury.
31 & 32	Dry slaked lime,	About 1 oz.,			Few larvæ on many plants,	No injury.
33	Common salt,	½ oz.,			Few larvæ on many plants,	No injury.
34	Nitrate Soda,	½ oz.,				No injury.
May 5. Row.						
1	Tarred paper pads,		120 per row,		No larvæ in some places,	No injury.
2	Tobacco dust,	Small handful around plant.	120 per row,			No injury.
3	Kerosene Emulsion,	1 to 15,	120 per row,		Eggs killed or washed away,	No injury.
4	Carbolic Emulsion,	1 to 25,	120 per row,		Eggs killed or washed away,	No injury.
May 24. Row.						
1	Table salt,	1 teaspoonful,	50,	Several weeks,	0 per cent.,	No injury.
2	Table salt,	1 tablespoonful,	50,	Several weeks,	0 per cent.,	No injury.
3	Nitrate soda,	1 teaspoonful,	50,	Several weeks,	0 per cent.,	No injury.
4	Nitrate soda,	1 tablespoonful,	50,	Several weeks,	0 per cent.,	No injury.
5	Carbon Bisulphide,	1 pipette,	50,	Several weeks,	100 per cent.,	No injury.
6	Carbon Bisulphide,	2 pipettes,	50,	Several weeks,	100 per cent.,	No injury.
7 & 8	Carbolic Emulsion,	1 to 25, ½ pt. per plant.	50,	Several weeks,	Not 5 per cent.,	No injury.
9 & 10	Carbolic Emulsion,	1 to 30, ½ per plant.	50,	Several weeks,	Not 2 per cent.,	No injury.
11	Gasolene,	About 1 tablespoonful,	50,	Several weeks,	100 per cent,	Plants wilted.
12	Gasolene,	1 teaspoonful,	50,	Several weeks,	100 per cent,	Plants wilted.

TREATMENT FOR SCALE INSECTS.

We find it necessary to publish again in condensed form the best treatment for scale insects and especially for the San José Scale. Various sprays can be used with successful results, but none is so generally satisfactory in killing the scale and in beneficial effects upon the trees or low cost of material as is the Lime-Sulphur Wash. This sould be boiled, strained and sprayed thoroughly over the trees in two coats, one to follow the other at any time after the first coat is dry.

The formula for the Lime-Sulphur Wash is as follows:

Seventeen pounds of Sulphur.

Twenty-two pounds of Lime.

Water enough to boil for one hour, and cold water added to make the whole amount fifty gallons.

Slake the lime in a little water in a vessel in which it is to be boiled. Mix the sulphur into a paste with water and add it at once to the Lime. When the Lime is slaked add enough water to let it boil, stirring it, and letting it boil for one hour. Strain it through a wire strainer with at least twenty-eigh meshes to the inch, and spray it thoroughly over the trees in two coats, leaving no spot untouched.

The formula:—There are a great many modifications of this formula, but the variations are not important. More or less of any one of the ingredients can be used with excellent results. Many persons use different formulas, but the general principle is the same, and the results are satisfactory if the work is thoroughly done. The three most important points in using the Lime-Sulphur Wash are:

1. Get the materials together and boil them at least one hour.
2. Strain well through a fine wire cloth.
3. Spray it thoroughly over the trees in two coats, so as to leave no bark or twig untouched.

All dead and dying wood should be cut out as should all branches that are too long to be reached and thoroughly covered by the spray.

Sulphur:—The Sulphur can be either in the ground form, which is sold as "Flour of Sulphur" or the sublimate which is sold as "Flowers of Sulphur," but the Brimstone or Stick Sulphur will not serve the purpose. Sulfur can be purchased from such firms as Powers-Weightman-Rosengarten, Philadelphia, Pa.; The Thomsen Chemical Company, Baltimore, Md., and the Bergen Point Sulfur Works, Burling Slip, New York, and others at less than $2.40 per hundred pounds.

Lime:—The Lime should be the Calcium Lime, which gives the color of cooked tomatoes when boiled with the Sulfur.

If the Magnesium Lime be used, it gives a dark olive green color, and does not seem to be quite so effective. With this kind of Lime

one-third more should be used. There is no easy method of testing the difference between these two Limes, excepting to boil them with Sulfur, and note the color that comes after boiling for at least three-quarters of an hour.

Quick Lime or Fresh Lime must be used if possible, but if this is not to be obtained a good plan is to slake a quantity and keep it in a barrel with a little water over it, and when needed dip out about three pounds of this Lime Putty or Wet Lime for each pound of Dry Lime that would be required in the regular formula.

Salt:—The Salt was omitted from the formula because it is found that the scale is killed without it, and it does not increase the efficiency of the mixture, but increases the expense and trouble of making it.

The Boiling:—Boil it in anything except copper, and put the materials together in any way and boil at least three-fourths of an hour of hard boiling, and this part of the work is finished. A good plan is to boil with steam from an engine or furnace by conducting the pipes to the bottom of the barrels containing the material. Copper must not be used, but a galvanized iron wash tub or common iron kettle can be used without injury. A small quantity can be boiled on the stove in any iron or tin vessel, and if the owner does not have a pump he can apply it with a brush and get good results. The advantages of the Lime-Sulfur Wash are in the efficiency of the material in killing the scale; its entire lack of injury to the tree or shrub of any kind when applied when not in leaf; its beneficial property in destroying the germs that would cause diseases of leaf or fruit; the cheapness of the material and the ease with which it can be obtained.

Spraying:—It is necessary to cover the trees with this material. It is not necessary that it be done with a spray as, if the trees be small enough to be reached with a brush, this will be an effective means of treating them. Two thorough coats should be given for the sake of being sure that the limbs have been covered entirely. If the wind be blowing spray the trees from one side and when it changes spray them from the opposite side. If the trees be near buildings, cover the sides of the buildings with protective cloths or papers as the material will stain. Use an extension rod made of three-eighths inch gas pipe, six or eight feet long, and on the end of this carry a cluster of two or three nozzles. An ordinary barrel pump costs about sixteen dollars ($16.00) for the complete outfit, and this is powerful enough to spray any ordinary fruit tree.

Commercial Insecticides:—Various Commercial Insecticides have some value and are to be recommended where a person can not find it convenient to use the boiled Lime-Sulfur Wash, as for example, on only a few trees. The objection to these Commercial Insecticides are that the expense is much greater than the Lime-Sulfur Wash,

PLATE LV.

Apple tree covered with Scurfy Scale but not pruned nor sprayed, showing how badly the Scurfy Scale can cover a tree, and that it is possible for this pest to destroy a tree if not treated. Small white specks, males; larger white specks, females. This tree was afterward pruned and sprayed with Lime-sulphur Wash, and is to be photographed this summer to show the results of spraying with this material.

Photographed for the Economic Zoologist in an orchard in Zeiglerville, Montgomery county, October 10, 1906.

PLATE LVI.

Rose Scale (*Diaspis rosæ*) on raspberry. A scale insect quite different from the others previously discussed or illustrated in these Bulletins, which attacks rose, raspberry, etc., and is to be killed by the same remedies as for the San José Scale.

Photographed in the office of the Economic Zoologist, natural size.

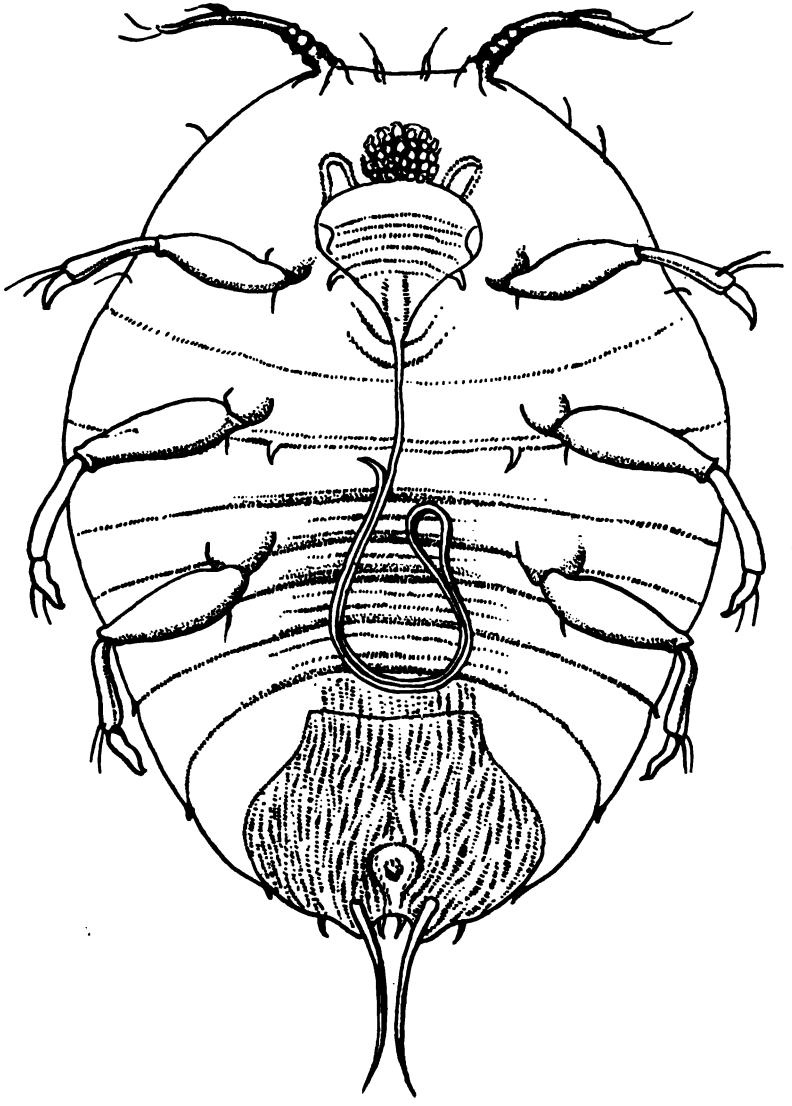

PLATE LVII.

Under side of young San José Scale, very greatly enlarged, showing the very long proboscis like a whip-lash. Drawn from Nature by W. R. Walton in the Office of the Economic Zoologist.

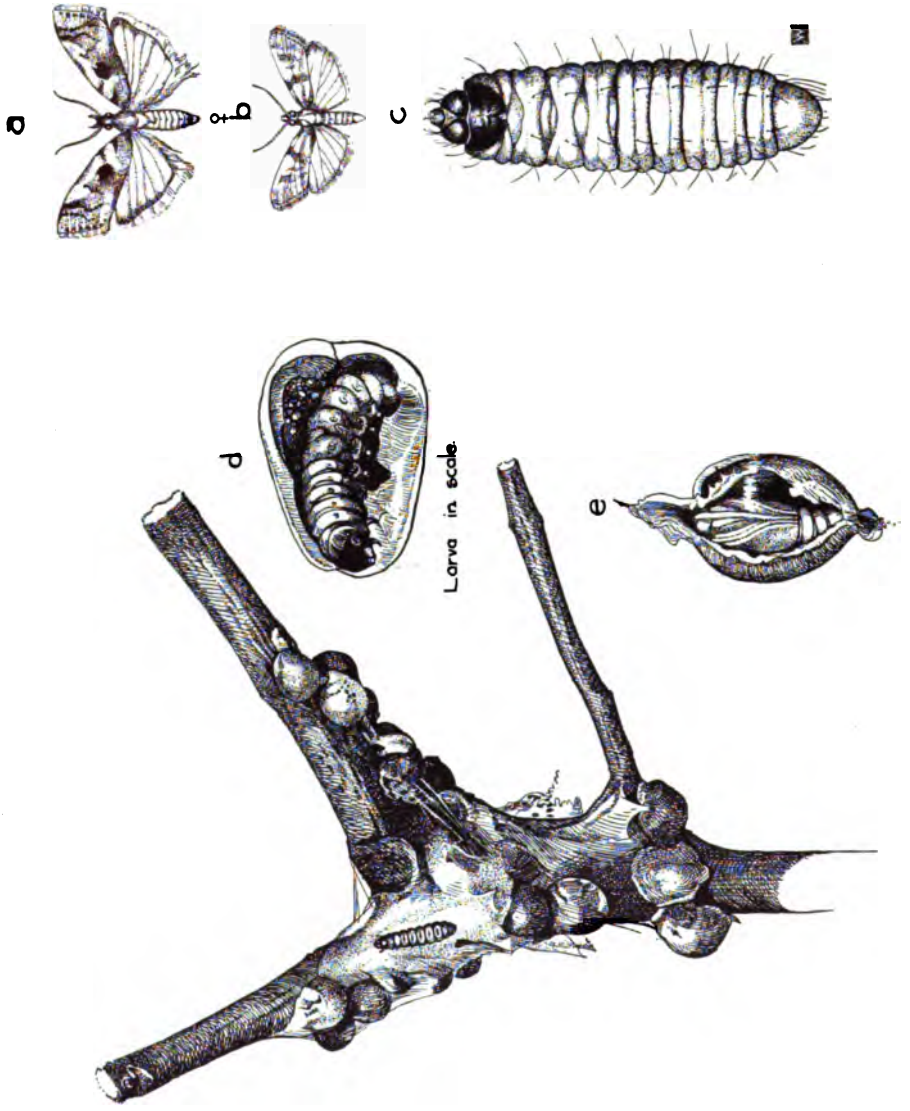

PLATE LVIII.

Moth larvæ (Laetilia coccidivora) destroying Turtle-shell Scale (*Eulecanium tulipifera*) on Magnolia tree. (a) female, enlarged four diameters. (b) male, enlarged four diameters. (c) larva, enlarged ten diameters. (d) larva feeding within scale, enlarged seven diameters. (e) pupa within scale, enlarged five diameters.

Drawn from Nature in the Office of the Economic Zoologist by W. R. Walton.

and if applied at the strengths advocated by the agents and manufacturers they will not give satisfactory results. Instead of the soluble oils, one part, to twenty parts of water, it is necessary to dilute with not more than twelve parts of water. This applies to such materials as "Kill-O-Scale," "Scalecide" and "Target Brand Scale Destroyer," and means that these materials will cost about ten times as much as the Lime-Sulfur Wash, when diluted and ready to be put on the trees. They will not injure any trees when in leaf when applied at this strength, but they are not fungicides and they do not leave a conspicuous stain where they have been applied, and where spots where missed as does the Lime-Sulfur Wash. It is important for the operator to see what parts have been missed.

HOW LATE SHALL WE SPRAY?

Spray until after the buds burst. Several persons have written that they have applied sprays to the green leaves before the blossoms appeared and killed the scale without having evil results. We saw peach trees sprayed when the pink of the blossoms was seen, with excellent results, both in killing the scale and in saving the trees and fruit for that year. Apple trees can be sprayed yet later. We know of successful spraying of apple trees as late as the fifth day of May. However, it is better to apply the material just before the buds burst rather than to wait until later.

THE SAN JOSÉ SCALE.

(Continued from p. 380.)

(Note.—If such a letter as the above were given for a commercial insecticide it would be printed and circulated by the hundreds of thousands as an advertisement. This should encourage fruit growers to persevere in the thorough application of the best and most economical insecticide and fungicide (combined) that they can procure, and try other materials only with caution, regardless of statements made by advertisers. H. A. S.)

The following Chester County persons had good results with lime-sulfur-salt wash: John H. Windrin, C. P. Barnard, Geo. W. Walton, H. W. Taylor, Robt. M. Simmers, Henry Pennypacker, E. J. Dunlap, Geo. W. Refsnyder, L. W. Pyle, Chas. McPherson, Robert Hughes, Chas. Roth, Barbara Good, Daniel Wilson, D. S. Newhole, C. Sheidle.

Clarion County.

Inspector Benjamin Evans.:
Number of Inspections, 38.

Clearfield County.

Inspectors: C. A. Heiss*, A. B. Lehman, C. C. Hess, Phillipsburg.
Number of Demonstrations, 4; Attendance, 40; Inspections ——.

Clinton County.

Inspectors: C. A. Heiss*, A. T. Baird, Island.

Number of Demonstrations, 16; Attendance, 230; Inspections, 246.

Testimonials:

Prof. H. A. Surface.:

Dear Sir: "There will be more lime-sulfur-salt used next spring than ever before. New pumps are being ordered, and they will be here in time for the work this time. M. J. C., Salona, R. F. D., sprayed his orchard last fall and will spray next spring.

The greatest difficulty is to get the people to do the work thoroughly, when a man contracts to spray an orchard he often expects to do the work in one day, and the owner is not a good judge of when the work is properly done. In windy weather no more than half of the tree is covered, and the L. S. S., is consequently condemned. It is a pleasure to refer all critics to the orchards of Earnest Moran, Thos. B. Myers and Dr. E. J. Baird, where trees that were badly infested, are now making a fine healthy growth, and are practically cleaned by the lime-sulfur-salt wash."

A. T. BAIRD.

"I use the formula in your Bulletin only I make it somewhat stronger. I believe that most of the failure with the lime-sulfur-salt spray is caused by not boiling it enough. I boil with steam, and have a small three-horse power boiler mounted on two wheels. I can hang it on behind a wagon and haul it anywhere with one horse. Three of us can make and spray five hundred gallons in one day if the trees are so situated that we can get at them easily. I think I shall do more spraying this spring than I did last year. Results are satisfactory."

H. S. BOLINGER.

Columbia County.

Inspectors: W. H. Brinkerhoff*, H. F. Shugars, Catawissa.

Number of Demonstrations, 4; Attendance, 128; Inspections, 270.

Crawford County.

Inspectors H. S. Loop, F. Z. Hartzell, Harrisburg, Pa.:
Number of Demonstrations, 2; Attendance, 20; Inspections, 9.

Cumberland County.

Inspectors, Dr. J. H. Funk, W. H. Brinkerhoff, W. H. Wolff, F. Z. Hartzell, Harrisburg, Pa.

Number of Demonstrations, 24; Attendance, 351; Inspections, 1488.

Testimonial:

No. 1.

"In the spring of 1903 I planted a number of apple trees. I was absent on the Pacific Coast until the fall of 1905. On my return I found several trees covered with the San José Scale, and some with the Oyster-shell Scale. In January, 1906, I prepared the Lime Sulphur-Salt Wash, as per formula given in the Monthly Bulletin, and applied it twice. I was absent during the past summer and returned November 1st, last, and I have been unable to discover any sign of scale, and the trees that were dead have taken new life and made a vigorous growth last summer."

R. GRACEY.

"In the spring of 1903, I planted a number of apple trees. I was absent on the Pacific Coast until the fall of 1905. On my return I found several trees covered with the San José Scale and some with the Oyster Shell Scale. In January 1906, I prepared the Lime-Sulfur-Salt Wash, as per formula given in the Monthly Bulletin, and applied it twice. I was absent during the past summer and returned November first, last. I have been unable to discover any sign of scale. and the trees that were nearly dead have taken new life and made a vigorous growth last summer.

I am sending under separate cover specimens plucked from some of the apple trees that were. Will you kindly give me information concerning them, also a few twigs that do not look healthy. Thanking you in advance for the information, I am,

Yours truly,

R. G.

(Note.—No. 8514. I could not find any scale insects, on twigs received. This is an interesting and important example of apparently completely cleaning up a case of bad infestation on apple trees by one thorough double treatment, according to our directions. —H. A. S.)

(Reply.)

Mr. R. Gracey,

Dear Sir: I have received the apple twigs which you sent to me, No. 8514, and which were covered with San José Scale and Oyster-shell Scale and sprayed in January, 1906, with the Lime-sulphur wash, according to the formula given in our Bulletin, making two applications. Upon careful examination of the twigs under a microscope we fail to find one scale insect of any kind alive. This scores a decided success for the Lime-sulfur wash and equals the best that has ever been reported of any material whatsoever, and confirms my opinion more fully than ever before,—that I am positively right in saying without hesitation or reservation that it is the best and cheapest remedy known for the San José Scale. Your success lay in your two applications. With this material it is necessary to be thorough and to cover the trees entirely. Half doing it does not bring the result.

The specimens of insect eggs from your apple tree are the eggs of the Tussock Moth, which is a very common pest of fruit and shade trees, but generally is not very destructive because its enemies hold it in check quite decidedly.

Very truly yours,

H. A. SURFACE,
Economic Zoologist.

No. 2.

"In 1904 I discovered the first San José Scale on my plum trees. I found my apple orchard badly infested.—so bad that much of the fruit was not fit to use. I did not know what to do for it. Dr. Funk, of Boyerstown, held a demonstration on the farm of Mr. D. E., near Shippensburg. I attended this meeting to hear him talk and see him mix the lime-sulfur-salt. I bought a barrel spray pump about six years ago to spray for Codling Moth. I used Paris Green, one pound to one hundred and sixty gallons of water, with very good results. Scarcely a wormy apple is found. I spray three times a season, if the weather permits, first as soon as the blossoms fall, then eleven days apart.

After Dr. Funk's demonstration I bought a large iron kettle,—one hundred gallons. I make twenty gallons of boiling water, then I throw in at the same time forty pounds fresh lime and thirty pounds flowers of sulfur. Boil one hour, then add fifteen pounds of salt and boil fifteen minutes. I stir the mixture all the time, then dilute to ninety gallons. Thus I sprayed my orchard of about one hundred apple trees thoroughly last fall and repeated it in the spring. I am certain I destroyed over seventy-five per cent. of the

scale. There is still some of the fruit marked with scale. I intend to repeat spraying in this way as soon as the leaves have all dropped. My orchard never had as many apples as it had this season. I was much laughed at by my neighbors while spraying. Now some of their orchards are entirely dead and others nearly so, and they are glad to come and get apples.

Yours truly,

D. S. LESHER.

Mr. S. S. Rupp, Orchadist, Shiremanstown, reports that the scale was absolutely cleaned up and exterminated on his plum trees at the public demonstration that was given in the presence of our field demonstrators in March, 1905. He says he finds no living scales at the present time, although they were badly infested when treated with the lime-sulfur wash.

No. 3.

Mr. Jacob Rife, of West Fairview, attended the meeting of the State Horticultural Association in Lancaster expressly to see us make the Lime-sulphur-soda Mixture, and went home and tried it in his orchard which was as badly infested as any orchard in the State. His report is most highly gratifying, and we consequently give it in detail.

"I used 4½ pounds of caustic soda, such as is prepared and sold for making soap, 17 pounds of sulphur and 33 pounds of lime and 50 gallons of water. I put the unslaked, fresh quick lime into a barrel, and mixed the sulphur in hot water to a paste, and poured it over the lime, and then put in enough water to slake the lime well. This made it boil fearfully, but I kept the barrel covered with heavy carpet to keep in the heat, and at the same time making a much more intense heat than could have been obtained by ordinary boiling. As soon as this boiling from slaking the lime had ceased, I added the caustic soda, and it again boiled harder than ever. As soon as all the boiling had stopped, I added enough water to make the entire mixture equal to 50 gallons, and then sprayed it on my trees, going over the trees immediately from the same direction the second time in order to cover the spots that were missed the first time; and then again when the wind changed, I went over them, and sprayed from the opposite direction twice in order to be sure that the entire surface of every part of every tree would be properly covered. I applied six barrels of this mixture to two hundred trees in two thorough sprayings and two hasty re-sprayings. That is six barrels in all, but if the wind had not been blowing so that considerable material was wasted, it might have been possible to have done the same work with only four barrels.

The results were so gratifying that I wish nothing better. Every person, who saw the miserable condition of my orchard last year, and saw the same orchard this year loaded with the finest fruit and scarcely a scale to be found anywhere, says that it is simply remarkable, almost marvelous. While it may be slightly more expensive than the Lime-sulfur Salt Wash, boiled, it is certainly less troublesome, and the slightlyly increased expense is not enough to be important. I sold a first-class crop of peaches from those trees this year, and it appears that I shall not have to spray again for the scale inside of two years; yet it was such a tonic, cleaning up all kinds of diseases as well as insects that I shall repeat the spray with this mixture, even though the San José Scale does not develop in great numbers."

We wish to add that we saw Mr. Rife's peaches. and they were among the finest that were brought to the Harrisburg market. Of course, the fact should be pointed out that he was exceedingly thorough and careful in his application. This, however, is as everyone should be who intends to do anything for this pest. Nothing else will bring success.

The following Cumberland County persons had good results with the Lime-Sulfur-Salt Wash, Thomas Hustler, Dr. Young, John Hale, M. Fletcher, F. R. Lieb, R. Felson, Jos. L. Best, Levi Fake, Aaron Coble, John G. Coder, S. C. Reeser, C. Givler, Wesley G. Miller, E. N. Cooper, C. T. Hopple, Wm. Jones, James May, J. W. Millhouse, Frederick Lance, Adam Reese, Benj. Fickes, B. F. Heberling, Wm. Yohe, G. Arthur Rea, Evans Bittner, John Kelly, Samuel Finkerbender, Wm. Reeder, Wm. Fry, Stewart Koons, Loy Byers, Jos. Thomas, M. M. Fiehl, Ab. Seaners, C. N. Naugle, A. F. Snake, John Woodburn, Daniel Mowrey, D. L. Allen, Wm. Dunlap, J. A. Brandt, Francis Mentzer, B. F. Heberling, D. H. Brandt, Geo. W. Himes, Dr. P. S. Koons. S. S. Rupp, Jacob Rife, J. D. Sprong, W. S. Pilgrim, H. C. Gish, G. A. Heims, J. C. Rummell.

Dauphin County.

Inspectors: M. H. Snavely, H. F. Shugars, James Hipple, Middletown; C. F. Noll.

Number of Demonstrations, 9; Attendance, 126; Inspections, 1164.

Testimonial:

Following is a list of the names of persons having good results with the Lime-Sulfur-Salt Wash in Dauphin county: Allen K. Walton, Chas. Hartrick, Robt. J. Walton, Isaac E. Coble, Aaron E. Brandt, Davis Stout, Daniel Engle, Geo. H. Bingman, John Bradley, J. J. Bishop, James Boyd, John A. Bomgardner, Henry Ubrick, E. C. Brinser, G. Lauffer, Josiah Brinser, S. H. Brinser, G. Frank Milleisen,

J. J. Shiffler, Josiah B. Foltz, S. R. Sheesley, John L. Beaver, W. J. Lescure, Martin Hocker, E. B. Mitchell, John Crum, John E. Hetrick, Wm. A. Hershey, H. J. Johnson, F. H. Wingard, J. H. Mattermas, L. B. Bowman, John Rathon, J. Walborn, Mrs. Chas. Weaver, Charles Polk, N. C. Freck.

Testimonial from Dauphin county:

Oberlin, Pa.—Rev. Chas. A. Hutton, at present a pastor in one of the churches at Oberlin, reported that two years ago his trees were dying with San José Scale and were so far gone that they were said by some persons to be dead. He sprayed all but one with the Lime-Sulfur-Salt solution in April, and all bore fruit that summer excepting the one not treated. While it was originally in the same condition as the others, it is now dead and they are in fine condition with an abundance of fruit buds on them and good prospects for further crops.

Delaware County.

Inspector: M. E. Shay, Tacony, Pa.

Number of Demonstrations, 3; Attendance, 74; Inspections, 261.

Testimonial:

"By persistent work and spraying with Lime, Sulfur and Salt Wash for three years I think I have successfully conquered the San José Scale. My trees were so badly infested that I had concluded to cut them down, and I do not find any scale present this year, and the trees have made a fine healthy growth."

P. D. JOHNSON.

The following Delaware county persons have had good results with the Lime-Sulfur-Salt Wash: Wm. Baker, Evans R. Smith, George Wood, W. T. Geary, Wm. C. Sproul, Mrs. J. E. Farnum, Wm. H. Miller, Edward Carey, George Darlington, Chas. J. Phillips, Thos. Long Cope, Casper Penwick, Elwood Bartram, Dr. Anna. M. Marshall, Geo. F. White, Solomon Knause, Victor Angerer, Ridley Park, Chas. H. Bean, Thos. T. Shoen, B. Robertshaw, Judge Wm. T. Potter, Isaac Snehard, Israel Lloyd, L. C. Dunn, J. C. Thompson, F. L. Paddock, Wm. Stewart, A. L. McGilton, Dr. Caspas W. Miller, Alvert Pharo, Miss Emily Forsythe, Mrs. Susan Carrett, Wm. Steigleman, Howard Ireland, Wm. M. Anderson.

Elk County.

Inspector: A. C. Finn, Clifford.

Number of Inspections, 14.

Erie County.

Inspectors: H. S. Lopp, E. Z. Hartzell, Harrisburg, Pa.
Number of Demonstrations, 9; Attendance, 277; Inspections, 519.

Fayette County.

Inspectors: W. Piper, H. H. Dutton*, J. K. Owene, Freeland.
Number of Demonstrations, 1; Attendance, 15; Inspections, 20.

Forest County.

Inspector, F. Z. Hartzell, Harrisburg, Pa.
Number of Demonstrations, 1; Attendance, 25; Inspections, 42.

Franklin County.

Inspectors: Dr. J. H. Funk, W. H. Brinkerhoff, Lees Cross Roads; F. Z. Hartzell, Harrisburg, Pa.
Number of Demonstrations, 9; Attendance, 270; Inspections, 616.

Testimonial:

No. 1.

"I am getting along as well as could be expected with my apple orchard. The entire orchard was infested with scale so badly that all the apples were more or less affected. I sprayed fall and spring with Lime-Sulfur-Salt and my last crop of apples had no scale marks. I have some scale but if I can keep them as they are now, what I have will do me no damage. I sprayed last fall with Lime-Sulfur and will do so again this Spring."

C. C. GELWICKS.

No. 2.

"My experience with the Lime-Sulfur-Salt Wash for the San José Scale has been entirely satisfactory in every case where I succeeded in covering every portion of the tree. This, however, is difficult to do, and required much time, care and material. A decided advantage in favor of this solution in comparison with the old treatment, namely, crude oil, is that in no case have I found any injury whatever to the trees from its use, which often occurs from the use of the oil.

Steam from an engine is the best method to boil it on a large scale. An ordinary kettle will answer very well when small quantities are needed."

J. H. LEDY.

Remarks by the Zoologist: We have been in Mr. Ledy's large orchards, and have seen them laden with fruit during the past two seasons. We note that he has learned from experience the dangers from the use of petroleum and the safety of the Lime-Sulfur Wash. —H. A. S.

No. 3.

"I sprayed with Scalecide thoroughly about three thousand apple trees, from three to seven years old, some of which were badly infested and some even killed. These apple trees were among peach trees that were badly infested, and which I did not spray until June, when I used Whale Oil Soap in order to save the fruit on the trees. These peach trees I have taken out. In November I again sprayed these same apple trees, some of which were again covered with the scale that were left alive. This spray kept them from destroying the trees, and I intend to spray them again before the buds burst. The three thousand peach trees I sprayed with Lime-Sulfur Wash, with the result that very few scale can be found. However, these trees were only slightly infested. I boiled the Sulfur and Lime with a steam boiler, which made it easy. I am satisfied that good Calcium Lime and Sulfur, properly boiled, will kill all the scale when properly applied, unless they are two thick, when, no doubt, it will require a second application. I had a fine crop of peaches on these trees and they are loaded with buds and in splendid condition to bear a crop this summer. I intend to use Lime and Sulfur on all my peach trees in the spring just before the buds burst. The orchard contains six thousand five hundred peach and two thousand apple trees, on a gentle rise up to the mountain, with a lot of never failing springs running through the middle of the orchard from top to bottom. This makes it very easy to boil Lime and Sulfur Wash, as I can run the water by gravity into the barrels, and one man can boil it fast enough for one Power Sprayer and one Pump or Barrel Sprayer.

I sprayed one whole day, on the 17th of April, peach trees that had small leaves grown, using Lime-Sulfur (boiled), and I did not injure a single leaf that I could see, but destroyed the scale, and the trees show very little scale at present."

L. L. SPRINGER.

Portion of Reply:

It is very interesting to know that you sprayed your peach trees as late as the 17th of April, after the small leaves had appeared, using the boiled Lime-Sulfur Wash, and did not injure the leaves, but at the same time destroyed the scale. This will help many persons this spring, who will be writing to us asking how late in the spring they can spray with the Lime-Sulfur Wash and not hurt the trees. From your statement it can be done even after the leaves are out. I think it can be done until the blossoms show.

I appreciate such letters as yours and hope to receive many of them.

Very truly yours,

H. A. SURFACE,
Economic Zoologist.

The following Franklin county persons have had good results with the Lime-Sulfur Wash: Samuel Mentzer, Aaron Rock, Geo. G. Rock, Henry Moats, Chas. O. Bowner, Wm. C. Stopps, John Walters, M. Mc. Flickinger, Crawford Bros., Samuel Reinhart, H. L. Lehman, J. A. Burkhart, Jacob Crammer, Geo. Cressler, A. C. Wenger, C. H. Cove, David F. Lesher, Bonner P. Gilmore, Geo. Maots, M. S. Hurst, Rummel, Himes & Co., C. M. Kuhn, A. L. Lehman, T. D. Small, J. H. Renfrew, J. D. Wingert, D. M. Wertz, Chas. West, Greenwood Fruit Co., Phillip M. Bikle, Jacob Reed, Geo. Talbert, H. M. Slaybough, G. W. Brushman, J. C. Kauffman, R. F. Renfrew, J. H. Ledy, Clayton Miller, L. L. Springer, J. M. Knoll, J. B. Knoll, John Eppie.

Fulton County.

Inspectors: A. B. Lehman, F. Z. Hartzell, Harrisburg, Pa.
Number of Demonstrations, 3; Attendance, 90; Inspections, 16.

Greene County.

Inspectors: W. S. Fisher, Harrisburg, Pa.; J. K. Owen, Freeland, Pa.
Number of Inspections, 98.

Huntingdon County.

Inspectors: D. K. McMillan, Gettysburg or Harrisburg; James Bergy, Mifflintown.
Number of Demonstrations, 13; Attendance, 336; Inspections, 464.
Testimonial:

Cassville, Pa., Jan. 31, 1907.

Dear Sir: In answer to your letter of recent date, I would say that I used the Lime-Sulfur-Salt Wash for the Oyster-shell Scale and Scurfy Scale in the proportion given in the June Bulletin for 1906, about the 20th of May. On the parts that were covered with the wash the scale was nearly all killed, but as it was applied with a brush it was impossible to cover all and in this way the foilage was not injured. I receive the Monthly Bulletins for which I am very grateful. Yours very truly,

J. C. CURFMAN.

Messrs. Joseph Yocum and Walter B. Gates are two persons in this County who had good results with the Lime-Sulphur Wash.

(To be concluded next month.)

SPECIMENS RECEIVED DURING JANUARY, 1907.

The State Zoologist recognizes obligations and expresses thanks to the following persons for specimens received during January.

Number.	Specimen—Insects.	Date—January, 1907.	Name and Address.
8429	Promethea Cocoons,	2	J. N. Knull, Harrisburg.
8430	Click Beetle Larvæ,	2	T. Oxford, Jr., Bangor.
8432	(a) Scurfy Scale, (b) White-marked Tussock Moth Eggs,	3	W. A. Rohrbaugh, Lineboro, Md.
8433	(a) San José Scale, (b) Lecanium,	3	P. Troutman, Bernville.
8434	(a) Cecropia Cocoon, (b) Polyphemus Cocoon, (c) Tussock Moth Eggs, (d) Oyster-shell Scale,	3	R. Shooter, Duboistown.
8435	(a) Promethea Cocoons, (b) Aphid Galls (Pemphigaus vagabundus),	3	A. Twining, Scranton.
8436	(a) Scurfy Scale, (b) Oyster-shell Scale,	3	F. J. Loomis, Milan.
8437	(a) Louse Fly, (b) Bird Lice,	3	Dr. B. H. Warren, Harrisburg.
8442	Cynip Galls,	4	Dr. I. M. Wells, Harrisburg.
8445	Oyster-shell Scale,	5	Mrs. A. Ingersoll, Emporium.
8447	(a) Promethea Cocoon, (b) Cecropia Cocoon, (c) Water Beetle (D. fasciventris),	7	E. A. Baron, McKean.
8452	(a) Galls of Cecidomyia rigidæ, (b) Cecropia Cocoon,	8	A. G. Irons, Port Allegany.
8453	(a) San José Scale,	8	J. O. Gardner, York.
8457	San José Scale,	8	C. E. Ross, Sunbury.
8461	Scurfy Scale,	9	J. C. Cole, Waynesburg.
8462	Lecanium,	9	A. J. Ziegler, Carlisle.
8463	Scurfy Scale,	9	F. S. Parvill, Lundys Lane.
8469	Lecanium,	10	Dr. O. T. Cruikshank, Swissvale.
8470	Oyster-shell Scale,	10	I. W. De Walt, Parkers Landing.
8472	Hickory-borer (C. pictus) Larvæ,	10	J. Couch, Hickory.
8473	Sour Flies (Drosophilidæ),	10	B. S. Rinehart, West Moshannon.
8476	San José Scale,	14	L. D. Stever, Springtown.
8478	Tree-cricket Punctures,	14	L. S. Ensworth, Warren.
8481	San José Scale,	15	W. S. Stryker, Alexandria.
8482	(a) Scurfy Scale, (b) Wooly Apple-aphis,	15	P. E. F. Miller, Heidlersburg.
8483	(a) San José Scale,	15	A. M. Reading, Wrightstown.
8484	Katydid Eggs,	15	J. A. Rittenhouse, Lorane.
8487	(a) Ground Beetle Larvæ, (b) Hickory-borer Larvæ,	17	J. Couch, Hickory.
8489	Flea Beetles (H. ignita Ill.),	19	E. Perkins, Athens.
8492	(a) Scurfy Scale,	21	D. W. Benedict, Selberlingville.
8493	(a) Oyster-shell Scale, (b) Lecanium Scale, (c) Scurfy Scale,	21	J. T. Donnon, Sewickley.
8494	San José Scale,	21	J. T. Stubbs, Drumore.
8496	West India Peach Scale,	21	J. D. Sayer, Bainbridge, Ga.
8497	Lecanium,	21	Mrs. W. H. Osborne, Athens.
8498	San José Scale,	21	M. H. Musser, Lancaster.
8501	(a) Tussock Moth Eggs, (b) Lachnosterna Larvæ, (c) Wasp Cocoons, (d) Scavenger Beetle (A. inquinatus),	22	M. R. Good, Narvon.
8503	Bagworms Cocoons,	22	S. Hopkins, Quarryville.
8504	San José Scale,	22	F. W. Nesbit, Oakdale.
8505	(a) San José Scale, (b) Cicada Egg Punctures,	22	W. H. Gass, Paxinos.
8507	Tree Cricket Egg Punctures,	22	W. L. Soule, Middlebury Centre.
8508	Katydid Eggs,	22	N. P. Rodgers, Jefferson.
8512	(c) Polyphemus Cocoon,	22	C. J. Knipe, Marietta.
8513	(b) Scurfy Scale, (c) Wooly Apple Aphis,	22	N. N. Naginey, Milroy.
8514	Tussock Moth Eggs,	22	R. Gracey, Newville.
8515	(a) Scurfy Scale, (b) Tomato Sphinx (P. 5—maculatus),	22	J. Vallerchamp, Jr., Halifax.
8516	(a) Clover Worm (Pyralis costalis), (b) Micro Lepidoptera Larvæ,	22	L. S. P. Heeter, Emlenton.
8522	(a) Wireworm, (b) San José Scale,	24	W. K. Warden, Oxford.
8523	Lecanium,	24	E. P. Miller, Altoona.

Specimens Received During January—Continued.

Number.	Specimen.	Date—January, 1907.	Name and Address.
8526	(a) Scurfy Scale,	25	S. M. McHenry, Indiana.
8527	Scurfy Scale,	25	J. A. Freedline, Dayton.
8530	(b) Cecropia Cocoon,	25	W. C. Dickson, Wayne.
8531	San José Scale,	25	S. Niece, Stockton, N. J.
8532	Oyster-shell Scale,	26	Miss E. Worden, Harrisburg.
8533	(a) Bird Louse from Grosbeak,	28	J. W. Hause, Newfoundland.
8534	San José Scale,	28	L. L. Springer, Edenville.
8535	San José Scale,	28	A. A. Burkett, Klahr.
8536	Stored-product Pest (S. panicea),	29	T. Kachline, Easton.
8537	Greenhouse Scale (C. aonidum),	28	W. M. Fryer, Pottstown.
8538	Lecanium,	30	A. E. Ricksecker, Warren.
8540	Red-humped Appleworm (S. concinna),	31	R. Dickson, Pittsburg.
8541	Scurfy Scale,	31	E. J. Nicholas, Mt. Bethel.
8543	Lecanium,	31	J. Pile, Barronvale.
8544	Bagworm Cocoons (T. ephemeraeformis),	31	A. R. Leinbach, Leinbachs.
	Invertebrates not Insects.		
8431	Trichina,	2	E. Hower, Perulack.
8436	(c) Mites,	3	F. J. Loomis, Milan.
8453	Mites,	8	J. O. Gardner, York.
8468	Centipede,	10	J. S. Snelbaker, Dover.
8492	(b) Mites,	21	D. W. Benedict, Selberlingville.
8493	(d) Mites,	21	J. T. Donnon, Sewickley.
8512	Spider Eggs and Cocoon,	22	C. H. Knipe, Marietta.
8528	(b) Mites,	25	S. M. McHenry, Indiana.
8530	(a) Spider Cocoons,	25	W. C. Dixon, Wayne.
8545	Spider, Lycosidæ,	31	C. A. Hickman, Steelton.
	Reptiles and Batrachians.		
8439	Common Garter Snake (T. sirtalis),	4	W. H. Brinkerhoff, Lees Cross Roads.
8441	Rock Snake (S. dekayi),	4	O. Shuman, Montgomery.
8446	House Snake (L. d. triangulus),	7	R. F. Miller, Philadelphia.
8447	(d) Snapping Turtle (C. serpentina),	7	E. A. Baron, McKean.
8449	Corn Snake (C. g. guttatus),	7	K. Geist, Covington, La.
8454	Garter Snake (T. s. dorsalis),	8	R. D. Rothrock, New Berlin.
8455	(a) Striped Water Snake (R. leberis), (b) Ring-necked Snake (D. punctatus), (c) Common Water Snake (N. sipedon), (d) Common Garter Snake, (e) 2 Blowing Vipers (H. platirhinos), (f) 2 Grass Snakes (L. vernalis), (g) 6 House Snakes, (h) Black Snake (B. constrictor),	8	J. P. Stober, Albright College, Annville.
8458	Hellbender (C. alleganiensis),	9	R. W. Wehrle, Indiana.
8459	Purple Salamander (G. porphyriticus),	9	W. G. Winner, Calvert.
8460	Purple Salamander (G. porphyriticus),	9	F. P. Beers, Dayton.
8464	Python,	9	J. Hope, Philadelphia.
8466	Blacksnake,	10	J. B. Richards, Barto.
8474	2 Brown Salamanders (D. fusca),	11	J. Couch, Hickory.
8477	Ring-necked Snake,	14	Dr. A. C. Wentz, Hanover.
8479	Spreckled Turtle (C. guttatus),	15	Dr. W. P. Snyder, Spring City.
8480	Mud Puppy (N. maculosus),	15	R. W. Wehrle, Indiana.
8496	Common Garter Snake,	21	Dr. O. T. Cruikshank, Swissvale.
8509	Rattle Snake Oil,	22	E. Meurer, Titusville.
8513	(a) Ring-necked Snake,	23	M. M. Naginey, Milroy.
8531	(a) 2 Newts (D. viridescens),	24	C. Shatto, Fort Hunter.
	Birds and Mammals.		
8427	Barred Owl,	3	Dr. B. H. Warren, Harrisburg.
8440	Cooper's Hawk,	4	L. Williams, Pine Station.
8443	Red-shouldered Hawk,	5	R. W. Wehrle, Indiana.
8448	White-footed Mouse,	7	J. Hafer, Lewisburg.
8456	Common Weasel (P. novebloracensis),	8	M. Couch, Hickory.
8467	Common Weasel,	10	W. H. Ridge, Trevose.
8486	Logger-head Shrike,	17	C. R. Robb, Alexandria.
8490	Screech Owl,	19	J. Q. Fertig, Dauphin.
8491	American Goshawk,	21	C. S. Fouse, Aitch.
8506	Blue Jay,	22	J. B. Richards, Barto.
8520	Cardinal,	23	G. Culp, Summit Point, W. Va.
8533	Pine Grosbeak,	28	J. W. Hause, Newfoundland.

SPECIMENS RECEIVED DURING FEBRUARY, 1907.

Number.	Specimen.	Date February, 1907.	Name and Address.
	Insects.		
8546	(a) Oyster-shell Scale, ...	1	G. B. Sims, Titusville.
	(b) Scurfy Scale, ...		
8547	Scurfy Scale, ...	1	A. S. Blackburn, Stahlstown.
8548	San José Scale, ...	1	D. W. Fisher, Transfer.
8550	Lecanium (S. hemisphaerica Targ.), ..	2	G. Beaulieu, Montreal, Canada.
8554	(a) Euonymus Scale, ...	4	L. J. Ladner, Mt. Holly Springs.
	(b) Scurfy Scale, ...		
8555	(a) San José Scale, ...	4	H. Smith, Devon.
	(b) Oyster-shell Scale, ...		
8556	White-marked (V. j-album), ...	4	Mrs. G. P. West, Danville.
8562	Scurfy Scale, ...	5	J. Bickler, Tamaqua.
8566	Scurfy Scale, ...	7	T. G. Peffer, Franklin.
8567	Scurfy Scale, ...	7	B. H. Smithes, Woodville, Kentucky.
8568	(a) Scurfy Scale, ...	7	D. A. Knappenburg, Lake Cary.
8570	Greenhouse Scale (C. aonidum), ...	8	W. L. Nesbit, Harrisburg.
8573	(a) Oyster-shell Scale, ...	1	H. S. Estabrook, Harford.
8574	(a) Stored Product Pest (S. panicea), ..	11	P. Kachline, Easton.
	(b) Work of Angoumois Grain Moth, ..		
8581	Scurfy Scale, ...	14	J. Ferster, Urban.
8583	(a) San José Scale, ...	14	W. H. Diehl, Northumberland.
	(b) Scurfy Scale, ...		
8584	(a) Oyster-shell Scale, ...	14	B. G. Coggler, Tobyhanna.
8586	San José Scale, ...	14	E. Styer(Pennsburg.
8589	San José Scale, ...	15	J. Dupensak, Sixmile Run.
8596	Scurfy Scale, ...	19	A. C. Myer, Everett.
8598	Oyster-shell Scale, ...	20	Mrs. G. P. West, Danville.
8606	Cottony Maple Scale (P. innumerabilis),	21	O. J. Woodruff, Lebanon.
8609	(a) San José Scale, ...	25	W. H. May, Wellsville.
8610	Collection of nearly seventy determined inflated Lepidoptera Larvæ, showing work, ...	25	R. Dickson, Pittsburg.
8611	(a) Oyster-shell Scale, ...	25	F. S. Palmer, Bradford.
8612	San José Scale, ...	25	W. Ely, Stony Run.
8616	(a) Bird Lice on Cattle, ...	26	E. J. Atkins, Roulette.
	(b) Bird Lice on Chicken, ...		
8618	Hay infested with Clover Worm (P. costalis) with nine associated species of insects, ...	27	L. S. P. Heeter, Emlenton.
8619	(a) San José Scale, ...	27	T. H. Parker, Norristown.
	(b) Oyster-shell Scale, ...		
8622	Oyster-shell Scale, ...	28	M. B. Sterling, Kingsley.
	Invertebrates not Insects.		
8583	(c) Mites, ...	14	W. H. Diehl, Northumberland.
8604	(a) Leech, ...	21	R. F. Miller, Bridesburg, Phila.
8605	Mussels (Unio spp.), ...	21	R. F. Miller, Richmond, Phila.
8611	(b) Mites, ...	25	F. S. Palmer, Bradford.
8618	(j) Pseudoscorpions, ...	27	L. S. P. Heeter, Emlenton.
	Reptiles and Batrachians.		
8601	(a) Red Salamander (S. ruber), ...	21	R. F. Miller, Philadelphia.
	(b) Land Salamander (P. cinereus), ..		
	(c) Hoptoad (B. l. Americana), ...		
8602	Brown Salamander (D. fusca), ...	21	R. F. Miller, Philadelphia.
8603	Purple Salamander (G. porphyriticus), ..	21	R. F. Miller, Philadelphia.
8604	(b) Musk Turtle Shell (A. odoratus), ...	21	R. F. Miller, Philadelphia.
8620	Fox Snake (C. vulpinus), ...	28	W. F. Smith, South Norwalk, Conn.
	Birds and Mammals.		
8564	(a) Screech Owl, ...	6	R. W. Wehrle, Indiana.
	(b) Flying Squirrel, ...		
8569	Pine Grosbeak, ...	7	E. Quintin, Ariel.
8571	Brown Bat (V. fuscus), ...	8	R. W. Wehrle, Indiana.
8572	(a) 2 Java Sparrows, ...	9	J. Hope, Philadelphia.
8575	Brown Bat, ...	12	A. C. Spangler, Selinsgrove.
8580	(a) Canary, ...	13	J. Hope, Philadelphia.
	(b) European Goldfinch, ...		
8582	Cooper's Hawk, ...	14	J. B. Brilhart, Grant.
8597	5 White-winged Crossbills, ...	20	R. B. Simpson, Warren.
8600	Blue Jay, ...	21	J. B. Richard, Barto.
8607	(a) Crow, ...	22	R. F. Miller, Philadelphia.
	(b) Star-nosed Mole, ...		
8608	2 Pine Grosbeaks, ...	22	R. B. Simpson, Warren.
8621	2 Crows, ...	22	P. P. Mohr, Fogelsville.

OUR MONTHLY CHAT WITH READERS.

The Bulletin on "The Serpents of Pennsylvania" was published in September as the Combined Nos. 4 & 5 of the Monthly Bulletin of the Division of Zoology for August and September. The supply is now exhausted, and there is no law at present providing for a second edition or the printing of any larger number. For this reason a Bill has been introduced into the State Legislature by Representative Hibshman of Lancaster County, providing for the printing of a sufficient number of Bulletins of the Division of Zoology of the Department of Agriculture to meet our demands or the demands of the public, providing this does not exceed fifty thousand of any one issue. If this Bill should receive favorable action by both branches of the State Legislature and by the Governor and become a law, it will be possible for us to add twenty-five thousand more names to our mailing list, and reprint a few numbers of our Bulletins for which we have so many calls and which are entirely exhausted. The maximum number that can legally be published at present is twenty-five thousand and of course this is the limit of names that can be added to our mailing list. This list is now practically full and if Representative Hibshman's bill should not receive favorable action, it will be necessary to revise our mailing list at once in order to reduce the list sufficiently to add the names that are being received daily, or discontinue the Bulletins. In this event the April number will be the last to be prepared and if the publication of the Bulletin should be discontinued, or if it be necessary for the Monthly Bulletin to be changed to Quarterly Bulletins we shall announce this in No. 12 of Vol. IV., which will be the April issue. The Bill, which must receive favorable action in order to continue this work, is House Bill No. 316, introduced by Mr. Hibshman of Lancaster County, and is entitled, "An Act to provide for the printing and distribution of an increased number of the periodical Bulletins of the Division of Zoology, issued from the Department of Agriculture, and making an appropriation therefor." We have received thousands of letters from persons in various portions of this State saying that they were willing to do all in their power to aid the work of this office, but we have not had occasion to make a general call for assistance until now, when the time has come that it is necessary for every person who wishes these Bulletins continued to let it be known. Letters may be written at once to the members of the Senate asking favorable action upon House Bill No. 316 and its amendment, by Mr. Hibshman, providing for the printing of an increased number of the periodical Bulletins of the Division of Zoology. The amendment supplies the funds necessary for such publication and limits the use of the money to this particular purpose only. Letters should be sent either directly to the Legislators or to the Economic

Zoologist, who will see that they reach their destinations. Favorable action upon this Bill also insures a reprint of our Bulletin on Serpents, which is now entirely exhausted, and for which hundreds of calls have been received. It is the duty of all persons now receiving the Bulletins, and who wish them continued, to respond immediately to this request according to this suggestion. Such response will also greatly aid the work of this office, as we regret being obliged to reply weekly to hundreds of letters stating that the mailing list is full and more names can not be added without a law permitting an increase in the number of Bulletins published, or replying that the edition of any desired Bulletin has been exhausted and can not be supplied without special legislative action. Please give aid at once if at all. The bill has passed the House and at this writing is in the Senate.

This list was revised last year for the purpose of such reduction, and by this means we obtained room for the names that have been coming in during the past year, but it is now nearly full again with the names of persons who have made actual requests for the Bulletins, and we fear that a second revision will only result in considerable correspondence, without the benefits that could come from the legislation desired. If our mailing list be revised again we shall announce the fact in the next Monthly Bulletin.

Specimens desired: Readers will note that we have given credit for the specimens received each month, and we wish to make the announcement that we desire all kinds of insects and all creatures that may act as enemies of insects, such as reptiles and amphibians, including the serpents, turtles, lizards, salamanders and frogs, and we wish specimens of those birds and mammals or higher animals that can be legally killed in this State. We are not authorizing any persons to make a business of collecting for us nor to collect any specimen illegally, but we are anxious to receive for our studies and for our Museum as many individual specimens as possible of the kinds indicated.

Small specimens may be sent by mail and larger packages may be sent by express, at our expense. Recognition of all material is made both by letter and in our publications, and information is given concerning them free of charge. Suspected destructive insect outbreaks should be reported to us at the first opportunity and always send specimens of the suspected insects for our determination.

Now is the time to obtain information and material for the campaign of the year against plant pests and diseases, and we shall be glad to receive and answer all questions pertaining to our profession. Send specimens whenever possible.

Address all communications to H. A. Surface, Economic Zoologist, Harrisburg, Pa.

THE MONTHLY BULLETIN OF THE DIVISION OF ZOOLOGY FOR MARCH, 1907.

Volume IV, No. 12.

Established in April, 1903, at the office of the Economic Zoologist.
Edited by H. A. Surface, Economic Zoologist, Harrisburg, Pa.

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OUR MONTHLY CHAT WITH READERS.

House Bill No. 316 Safe.—In our last Bulletin the statement was published that House Bill No. 316, providing for the publication of an increased number of the Monthly Bulletins, and for the re-publication of some of those which are now exhausted, was in danger of defeat, and that interested persons should take such steps as they thought best to secure the passage of this bill. It was perhaps fortunate that, due to a great rush with the legislative bills by the printer, that Bulletin was delayed until such time as the March and April numbers would be mailed together, for the reason that it saves considerable writing on the part of our readers and annoyance on the part of the legislators, who already have heavy correspondence on many bills. Fortunately, this bill is now in good shape, and will doubtless receive favorable action by the Senate and the Governor. Although the amendment providing for funds failed in the House, the bill passed, and was amended in the Senate. We hope to be able to announce in the next Bulletin that the legal limit is increased to fifty thousand, and that more names can be added to our mailing list, as well as provisions having been made for the re-publication of the Serpent Bulletin, which is now exhausted.

It is surprising what a large number of letters, and especially postal cards, are mailed without the address or signature of the writer. Frequently persons make requests of this office for information, and we can do nothing more than wait to hear from them again, when they sometimes make inquiry as to why their previous communication was not answered. When the writer is from a small postoffice, we sometimes return the communication to the postmaster with the hope that the latter can aid us in finding the writer.

Almost as careless as to send a communication without address or signature is the custom of sending specimens without the name or address of the shipper. Whether specimens of any kind be sent by mail or express, they should always be placed in a box or vessel that will not be easily crushed, and the name and address of the sender should be plainly written on the outside or on a slip of paper placed inside. The importance of this request is to be respectfully impressed upon the minds of contributors. When several packages are received by the same mail, the absence of identification marks often leads to confusion and impossibility of accurate replies.

The circular letters sent directly from the State Museum (which is yet to be organized) did not emanate from this office and specimens sent there at present do not reach the State Zoologist nor aid his investigations. He continues his request for specimens for his office.

H. A. SURFACE,
Economic Zoologist, Harrisburg, Pa.

SAN JOSE SCALE IN PENNSYLVANIA.

(Concluded).

Indiana County.

Inspector: James Fergus, Elizabethville, Pa.
Number of Demonstrations, 1; Attendance, 10; Inspections, 21.

Jefferson County.

Inspector: A. O. Finn, Clifford, Pa.
Number of Inspections, 93.

Juniata County.

Inspectors: T. C. Foster, Winfield; James Bergy, Mifflintown.
Number of Demonstrations, 8; Attendance, 134; Inspections, 58.

Testimonials:

No. 1.

"With all the heroic effort to subdue and exterminate the scale, with four years experience, and holding the nozzle myself, would say I have found nothing to equal the Lime-Sulfur Wash, well boiled. I have used it all these years for scale, and they do me no harm now, altho I do not say it utterly exterminates them. I spray everything, scale or no scale. I sprayed during November and December and expect to repeat it again in the spring. I have no scale on peach, and you know how badly they were covered when you saw them, but there is yet a little on the plum and pear trees.

And with all this would say that you might as well try to exterminate every potato bug, every caterpillar or every other insect as to say you would exterminate every scale, but keep up the spraying and it so thoroughly subdues it that it will do you no harm.

If you could get the people to pull out their old peach orchards and trees that have the yellows, and cut down all worn out apple trees, this would do much to accomplish the desired object."

Yours truly,

Wm. Banks.

No. 2.

Mifflintown, Pa., November 19, 1906.

"I went to see the peach orchard of Mr. John Moore, Lewistown, Mifflin county, who cut the tops off eight hundred peach trees that were badly infested with the San José Scale last April, and then sprayed them with the Lime Sulfur Wash. Six hundred of them had

made a strong growth of new wood, and the greater part of the trees are full of fruit buds, and I could not find any scale on them. The others were practically dead when treated and could not recover."

James Bergey.

Note.—This shows the practical and beneficial results of "dehorning" and then treating thoroughly with Lime-Sulfur Wash, either with paint brush or spray pump. This is the method we advocate for very badly infested trees when comparatively young, and for peach and plum trees of any age.—H. A. S.

The following Juniata county persons have had good results with —the Lime-Sulfur-Salt Wash: E. Woodward, Jacob Basom, John H. Shellenberger.

Lackawanna County.

Inspector: W. B. Packard.
Number of Demonstrations, 1; Attendance, 25; Inspections, 58.

Lancaster County.

Inspectors: J. D. Herr, American House, Reading, or Millersville, Pa.; E. C. Bowers, E. Petersburg, Pa.
Number of Demonstrations, 50; Attendance, 881; Inspections. 1531.

Testimonial:

"I sprayed with Lime-sulphur-salt last fall and spring, and my trees are more free from scale than for several years. Yet I have some scale remaining.

Lime-sulphur-salt is all right, and I think acts also as a fertilizer, but it is hard on sprayers and very troublesome to make."

Yours truly,

F. S. Weinhold.

The following Lancaster county persons have had good results with the Lime-sulphur Wash: M. D. Kendig, J. G. Resit, Ezra B. Engle, A. W. Root, F. G. Harple, A. H. Erb, B. B. Burkholder, Henry Hoffman, John Geigley, Jos. Hibshman, J. H. Frank, Jacob Landis, Jacob Konigmacher, Henry Romig, Benj. Hoover, Wm. DeHaven, John H. Weaver, Samuel Zimmerman, James Lichty, Geo. Morgan, H. C. Lintner, J. S. Reist, F. S. Stover, Rev. Jno. W. Schlosser, Harry H. Foltz, L. H. Shenk, D. W. Dunlap, J. H. Hostetter, G. B. O. Felty, Harry Afflebach, W. R. Hoover, A. H. Baer, John B. Smucker, Frank Gless, J. C. Brubaker, John Burkholder, Davis P. Coldren, Geo. Shober, Harvey Leid, Abram Groff, M. M. Winger, John S. Zook, Jos. H. Beiler, John H. Warfel, C. K. Kreider, John S. Weidman, Isiah Gibble, Ezra Graybill, Samuel L. Graybill, C. B. Hess, J. H.

Gochman, S. R. Nissley, Harry Longnecker, Zachariah Farry, Christian Snyder, M. E. Lindemuth, Joseph Musser, John G. Reist, C. B. Hess, H. M. Risser, J. A. Engle, Ephriam Brinser, Dr. S. T. Davis Geo. W. Walton, J. E. Baker, D. M. Eyer, Christian N. Nolt, Elias J. Nolt, Henry Baer, Israel Stauffer, F. S. Stover, John A. Von Neida, Henry LeVan, E. K. Hershey, A. B. Frey, John Schock, Cyrus Lutz, D. H. Mellinger, Enos H. Hess, Benj. Wiggins, G. W. Kise, S. B. Kise, A. M. Aument, A. H. Kauffman, Willis Herr, Prof. J. L. Schroy, Ezra H. Mellinger, Norman Christ, Abraham Nicholas, D. H. Landis, F. F. Brenner, J. R. Yentzer, E. H. Kauffman, Dr. J. Harry Musser, Abraham H. Witmer, L. B. Weaver, Alfred Kendig, Addison M. Benedict, G. W. Pries, Jas. Charles, E. H. Zercher, A. M. Charles, Mrs. J. W. Cooper, Amos M. Landis, H. H. Stehman, J. W. Arnold, Wm. Lebzelter, Mrs. Lewis Sprecher, S. D. Stauffer, F. A. Reiker, R. D. Herr, J. W. Brenneman, C. R. Eshleman, John R. Herr, Amos Shawback, Amos B. Denlinger, Herman Eyman, Dr. I. H. Mayer, B. F. Wiggins, G. Gerstley, G. G. Eckman, Dr. M. H. Musser, J. W. Brenneman, Judge C. I. Landis, C. D. Herr, Abraham Nicholas, Harry Peters, Abraham Nicholas, A. K. Mann, Christian Hostetter, B. B. Gonder, A. M. Herr, J. L. Ranck, A. F. Trout, Hon. Hiram Peoples, Isiah Herr, M. T. Reeder, A. B. Myers, Amos McAllister.

Lawrence County.

Inspector, J. W. Cox, New Wilmington.

Number of Inspections, 492.

Messrs. M. I. Buchanan, J. F. McFarlane and John Parker have had successful results with the Lime-sulfur-salt Wash.

Lebanon County.

Inspector, M. H. Snavely.

Number of Demonstrations, 17; Attendance, 136; Inspections, 223.

Testimonial:

Annville, Pa., R. F. D. No. 2, Jan. 28, 1907.

"I have about 5 acres of land. Some fruit trees were troubled badly with San José Scale, especially on the apple trees, but I sprayed with the Lime-Salt-Caustic-Soda wash twice, two years ago this winter and once a year ago. One apple tree was nearly dead, one was very full of scale, and one crab apple was dead except the trunk, so I cut off all the limbs and washed the trunk with the wash. Now the limbs are healthy and look nice, but the trunk is rough and spoiled, otherwise I am not troubled with the scale in the orchard except now and then you can find one. Around the house on the peach trees it is present in great numbers, and I intend spraying these.

I also used it on currants, and we had more and nicer currants than ever before. I also sprayed Paris Green for the Codling moth in the spring and several people said they never saw any nicer apples for the early one than we had, and that tree I thought would die of the scale."

A. U. B.

The following Lebanon County persons have had good results with Lime-sulfur-salt Wash: Jacob Helm, J. H. Bassler, Albert Patches.

Lehigh County.

Inspector, E. C. Bowers, E. Petersburg.
Number of Demonstrations, 20; Attendance, 475; Inspections, 144.

Testimonial:

Prof. Geo. C. Butz, of State College, one of our State Nursery Inspectors, reports that Mr. W. B. K. Johnson, of Allentown, Lehigh county, so completely eradicated the San José Scale in the orchards that he treated last spring with the lime-sulphur-salt wash that it was absolutely impossible for the Inspector to find any specimens of the Scale in those orchards during the August inspection, although they were previously infested.

Following is a list of Lehigh county persons who have had good results with the Lime-sulfur Wash: Tilgman J. Kohler, Harry Schaeffer, H. B. Shelly, Peter H. Krumm, L. B. Geiger, Lewis A. Sterner, C. A. Gackenbach, Thos. P. Roth, Frank Nagle, C. K. Lichty, W. B. K. Johnson, Isaac B. Myers, Percy Fenstermacher, W. H. Walbert, W. J. Sleifer, Thos. R. Kohr, Johnston Nursery.

Luzerne County.

Inspector, H. F. Shugars, Catawissa, Pa.
Number of Inspections, 104.

Testimonial:

"In compliance with directions of the inspector from your department, at the time of his visit here, we used the lime, sulphur and salt mixture as per his instruction, and are glad to report that we think the ravages checked. We will continue the application at regular intervals, fall and spring, as advised."

B. D.

Lycoming County.

Inspectors, W. B. Packard, W. G. Winner, Calvert.
Number of Demonstrations, 31; Attendance, 308; Inspections, 384.

Testimonial:

Lycoming, Co.

"You want to know what effect the spraying had on the San José Scale. As far as I can see there is no scale living on the trees that you sprayed during the demonstration last spring. When we sprayed the rest of our trees this spring, we found two other trees with scale, but we think they are all dead now. Our trees are doing well. We have 165 baskets of peaches this summer. We consider this remarkable as there were but few in our neighborhood beside ours. We think that the Lime-sulfur Wash is the thing to kill San José Scale, and if people use it as you taught them in our orchard they could keep them in check, so they would not do much harm. We think the State is doing a good work, but if the people do not make use of the knowledge they receive from the State it is their own fault and not that of the State."

R. R. McM.

Messrs. John P. Hamm and Wm. E. Entermarks report good results with Lime-sulfur-salt Wash.

Mercer County.

Inspector, J. W. Cox, New Wilmington.
Number of Demonstrations, 6; Attendance, 79; Inspections, 732.

Testimonial:

Messrs. G. Durst, J. O. Horner and J. A. Dillon report good results with Lime-sulfur-salt Wash.

Mifflin County.

Inspectors, D. K. McMillan, Harrisburg or Gettysburg; James Bergy, Mifflintown.
Number of Demonstrations, 14; Attendance, 376; Inspections, 266.

Testimonial:

The following Mifflin County persons have had good results with the Lime-sulfur Wash: John R. Moore, Alfred Baker, Chas. Anrand, Henry A. Erb, D. M. Kanagy.

Monroe County.

Inspector, J. K. Owen, Freeland, Pa.
Number of Demonstrations, 24; Attendance, 491; Inspections, 1609.

Testimonial:

Monroe Co.

"The peach trees I headed back so hard for your demonstration by Mr. Owens last winter, and which I thought would never thrive

again, have formed new heads and are well set with fruit buds. The demonstration held in my peach orchard was successful and cleaned the trees of scale. I touched them up again a day or two after the demonstration. I received your latest Monthly Bulletin on the scale which was very instructive."

Very truly yours, B. F. B.

No. 2.

"For San José Scale I used a Meyer's common barrel pump, costing $10, with a Jet Agitator. I boiled the wash in an iron kettle, but that was too slow. I afterward used a Farm Boiler, about one and one-half horse power, tested to 100 pounds pressure, and I aimed to carry forty pounds. This was connected with three coal oil barrels. Two of the barrels I used for boiling the wash, and the other for hot water. The boiler cost forty dollars.

I commenced spraying March 15th and finished May 13th, spraying about 5,000 trees from two to forty years old. On trees less than twelve years old I cannot find a scale. On the older trees there is a little scale left. My pump is too small for large trees. In fact, I think for large trees one needs something more than man power to do effective work. Very little of the spraying was done in my own orchard, as I have no scale.

On April 26th I commenced to spray an orchard of 24 acres with over 4,000 trees in it, consisting of apple, pear, peach and plum, from two to eight years old. I found San José Scale in this orchard four years ago, and there had been no treatment previous to my spraying, except that the trunks and lower limbs had been scrubbed with Whale Oil Soap. The scale was distributed over the 24 acres, and probably 500 trees were affected. I cannot find any scale now with the naked eye, and the trees are all in a healthy condition, and made a good growth the past season. A few trees have lost a part of their tops. When I sprayed the pear and plums they were white with blossoms. The wash killed two-thirds of the fruit of the pears and all of the blossoms on the Hale plum, but the Abundance, Nixon, Satsuma and Burbank plums had a very large crop. The wash did not seem to hurt these last-named varieties.

The tent-caterpillar cannot stand the Lime-sulphur-salt Wash any better than can my fingers. I now have a fine new growth of skin on my fingers, but I would advise anyone using this wash to wear rubber gloves for the hands and glasses to protect the eyes.

In this 24-acre orchard there were about 1,000 nursery trees about five to six feet high. Twenty-five per cent. of them had scale. Eight trees were killed. These trees would have been transplanted last spring had they been clear of scale. They are all clean now and ready to transplant.

Very truly yours,

Randall Bisbing.

Mr. Bisbing, who is the County Chairman of Farmers' Institutes for Monroe county, is obtaining good results with a Farm Feed Cooker, and has been persuaded to spray several orchards in Monroe County. We hear from the owners that satisfactory results have been obtained. Note the interesting results of spraying while the blossoms were present. It should, of course, be applied before this time, if possible, but we should rather spray with this wash in the middle of the summer than lose our orchard. Rubber gloves or mittens are best for protecting the hands. Leather is not injured after coming into contact with the Wash if first soaked in melted tallow. —H. A. S.

Following is a list of names of persons having good results with the Lime-sulfur-salt Wash in Monroe county: R. F. Swartz, S. B. Decker, Charles Bell, H. B. Decker, R. J. Kise, H. A. Croasdale, M. D. Demond, Eugene Heller, L. M. Tucker, Wm. H. Truslow, J. A. Shroder, Mrs. Simpson, H. G. Rhoades, Wm. C. Renwick, Jacob Hunsicker, B. F. Kapp, W. L. Ruff, Alfred LeBar, Phillip Peters, Paul Maden, L. Class, John Frederick, F. Stone, S. B. Decker, Dr. Hurd, Chas. Bell, Oscar Phillips, Harvey Terping, E. H. Palmer, Harry Stone, Harry D. Stone, Jr., David White, Frank Featherman, Franklin Beaver, Howard A. Marsh.

Montgomery County.

Inspectors: J. K. Davis, J. S. Briggs, Norristown, J. H. Hale.
Number of Demonstrations, 24; Attendance, 431; Inspections, 536.

Testimonial:

No. 1.

Narberth, Pa.

Prof. H. A. Surface, Harrisburg, Pa.:

Dear Sir: I have been fighting the scale for the last three years, and early last spring I used freely the mixture you recommended (Lime-sulfur-salt), and can now boast of having rid my trees of this awful pest, but another question arises. What about my neighbors? The fruit trees are dying all around me, and outside of the Pennsylvania Railroad Company no one is spraying or doing anything with this scale. If something is not done all my work has gone for naught. What do you suggest?

Yours very truly,
Prof. J. B. Alker.

Harrisburg, Pa.

Reply:

Prof. John B. Alker, Narberth, Pa.:

My Dear Sir: Replying to your letter of the 24th inst. I am very glad, indeed, to learn that you have obtained control of the dreaded San José Scale by spraying with the Lime-sulphur Mixture. It is very gratifying to know that in every county where this pest is found there are a few intelligent men who are succeeding with this material. I am sorry to have to say that I know of no other material that has given the satisfactory results that have been obtained with the Lime-sulphur Wash. You will understand that our notice to you was merely an effort on our part to help you and there is nothing compulsory about it.

Replying to your inquiry as to what should be done with your neighbors, I can say that this was at first a very perplexing problem, but it has now been proven conclusively that it does not make much difference whether your neighbors take care of their trees and shrubbery or not, as far as the San José Scale is concerned. This is a pest which you are not able entirely to exterminate, but can easily hold in check; this means that you will probably have to spray once per year, or at best, once in two years. It is my opinion that you can never entirely get rid of it, but to spray once per year your trees will be in better condition than though you had not sprayed, and you will find it decidedly profitable, and will at the same time hold the scale in satisfactory subjection. Consequently, it should not matter to you whether your neighbors spray or not, or whether a few individuals of this scale come across the fence from their orchards or not. The addition of a few specimens of San José Scale to your trees, that already have some upon them, will not mean the destruction of the trees, and consequently I would consider it economically unnecessary to force your neighbors to treat their trees. The scale will, in time, kill them and then they will probably plant others and let the scale kill them in turn, unless they be wise enough to see the results of your methods and follow your footsteps. However, if the pest were incurable, such as Pear Blight or Peach Yellows, I should certainly make use of the law in this case, and force my negligent neighbors to treat their trees. This means that if the Yellows be present, the trees should be pulled and burned, and if either Blight or Black Knot be present, it should be cut out and destroyed by burning as soon as it appears. The Law provides that the Department of Agriculture must take up such matters when notified, as it is the duty of the Secretary of Agriculture to send an inspector to the premises that are thus reported, and if the inspector find such pests, the owner must take such measures as are recom-

mended by the expert in charge. If he should fail to do this, it is the duty of the Secretary of Agriculture to have it done at the expense of the owner of the property for the actual performance of the necessary work.

I suppose you are receiving our Bulletins. If not they will be sent to you free.

Very truly yours,
H. A. S., Economic Zoologist.

No. 2.

Skippack, Montgomery County, Pa.

H. A. Surface, Economic Zoologist, Harrisburg, Pa.:

Dear Sir: Last April I had the pleasure of attending the Orchard Meeting on Governor Pennypacker's farm, near Schwenksville, where you explained and showed the method of preparing and applying the Lime-sulphur-salt Wash. Having a number of young trees, such as apples, pears, peaches and plums, which were badly infested with the San José Scale, I immediately purchased a barrel sprayer and sprayed my trees with this wash. Two of my first apple trees were dead, and one of the Japanese plum trees was so badly affected that I cut off about half of the top. The apple trees I replanted. In May before the buds appeared, I sprayed all of my trees with the Lime-sulphur-salt Wash. As a result the apple trees are in a fine condition. My peach trees were so badly affected that they bore no fruit this year, but the appearance of the trees now indicates that they will bring a good crop next year. The plum trees had a very good crop of fine fruit. Many of my neighbors, seeing my fruit and the fine condition of my trees, will apply the Lime-sulphur-salt Wash this fall.

I used the following number of pounds of each of the ingredients to make the wash:

Fresh unslaked Lime, ...	40 pounds.
Sulphur, ...	20 pounds.
Salt, ...	15 pounds.

I put fifteen gallons of water in an iron kettle and heated the water; then added the lime. After the lime was all slaked, I added the sulphur and the salt, boiling for two hours. Before adding the sulphur I mixed it with water, forming a paste so as to prevent it from forming lumps. When done the compound assumed a reddish color. When it was finished I added boiling water to make sixty gallons, and then applied it to the trees. I strained the liquid before putting it into the barrel, and thus avoided clogging the nozzle. In

spraying I am careful to cover the entire tree, branches and all, so that insects have no harbor for concealment. I am using more lime than you recommended in your prescription, because I think more lime coats the branches better and does not wash off so soon by rain. This wash will not only destroy the San José Scale, but it will destroy many other insects that harbor in the bark and on the branches of the trees.

Those who follow the above instructions will be richly rewarded with a bountiful supply of choice fruit and fine trees.

This community, as well as myself, feel thankful to you personally for the instruction given us, and for the valuable information you give us through the Monthly Bulletin.

Very truly yours,
J. G. Rosenberry.

Following is a list of the names of persons having good results with the Lime-sulfur-salt Wash in Montgomery County: Courtland Dickinson, Dwight W. Moyer, Jacob B. Krous, Irvin S. Rhoads, John Moyer, Robert Toland, Miss M. K. Dickson, W. E. Slenn, J. C. Wallace, L. Becker, John Wanamaker, R. J. Brookes, John Saylor, Robert B. Haines Co. Nurseries, Krenson Nurseries, Wm. J. Hallowell, Prof. W. S. Campbell, M. B. Seipt, Mrs. Margaret Marshall, E. H. Chapman, John R. Park, J. Widmer, H. E. Pratt, H. B. French, H. B. Wonsetter, E. C. Bechwalter, R. G. Brooke, C. A. Wisner, Hon. S. W. Pennypacker, Wm. Bromer, Wm. H. Anders, J. Embick, J. Y. Ruth, E. M. Stover, Benj. Moyer, Abram H. Bergey, J. S. Hallman, B. W. Darnly, Eugene Dambly, Dr. John G. Rosenberry, John Godshall, F. P. Castle, Dr. S. C. Moyer, Simon C. Kulp, Ernest N. Rupp, Henry P. McKean, Geo. Krieble, J. C. Blattner, E. B. Smith, John A. Detweiler, Y. H. Swartz, A. M. Raer, Thos. W. Barlow, W. Hinckle Smith, J. B. Owber, J. R. Valentine, J. H. Converse, C. A. Warner, F. L. Warner, D. M. Ellis, J. B. Heckler, L. H. Kline.

Montour County.

Inspectors: W. H. Brinkerhoff, Lees Cross Roads; J. W. Battleyon; A. W. Stephens, Lewisburg, Pa.

Number of Demonstrations, 14; Attendance, 186; Inspections, 717.

Testimonial:

Messrs. E. G. Wertman, Frank Boyer and R. M. Cummins report good results from the Lime-sulfur-salt Wash.

Northampton County.

Inspector: P. R. Boltz, Lebanon.

Number of Demonstrations, 30; Attendance, 801; Inspections, 291.

Testimonial:

Northampton, Pa.

No. 1.

"I used the Lime-sulfur-salt Solution, as recommended in your Monthly Bulletin which you sent me, and which was properly prepared according to directions given, as the boiling was continued for an hour and one-half. I prepared the solution three times, as the capacity of the kettle was too smalll to make it all at once. The first and second time the color of the solution was the same, and the last time it differed from the first. I was unable to account for it, and being fortunate to get around I met the Demonstrator who was at Butztown on the 11th of Dec. I asked him, and he explained it to me. He told me it was due to the kind of lime I used, one being a Calcium and the other a Magnesium Lime. The last time I made it I had to buy more lime. (Evidently from another kiln.—H. A. S.) In the start I did considerable pruning, and a few trees I thought were beyond recovery have recovered themselves and did nicely last summer. The trees that I treated were Peach, Pear, Plum and Apple, Currant, Gooseberry, Lilac, and in fact, everything and anything that I thought might be affected, and I must say there is quite a difference in appearance of the foliage from the year previous. I examined the trees treated and I find some scale remaining, but this is due to my not making a thorough job, I think, in covering every part. They will get their medicine as soon as the time is here. Not having a sprayer I used a brush, and I know it repaid me for the time and trouble I gave them. I intend to go over them again this spring.

I receive the Bulletins regularly and am particular in reading them, and by so doing I find nearly all my questions answered through information which you give to others.

Having been rather unfortunate the past season in not being able to secure the specimens you ask for, I will try my best this next year to send you something which I hope may be of some benefit to you."

Very respectfully,

J. M. Jones.

No. 2.

"My experience with the Lime-sulfur Wash has been that it has done fine work in destroying the San José Scale. I often find people who are spraying with poor results for many reasons. The first is that the trees are so badly infested that they are beyond help. I find that if the inner portion of the tree is colored, spraying is of no use. I went on a man's premises who had been spraying and cut a piece of bark off of the tree and found that the heart was all

colored. I told him to cut all of those trees down. I heard another man ask him how he made his solution. He said, "I just threw the materials together and left the Lime to do the boiling." Some of his trees were free from the scale and others were full of scale.

I have seen some orchards that were treated in just this way. Mr. D. D. W..... does not do any boiling and he will pay you, or anybody who can find any scale on his trees, one dollar for every scale. He sprays every year with Lime-sulfur-and-soda.

His fruit brought the best prices wholesale, more than any fruit grower I know. I am glad to say that I have gotten quite a great many people interested in spraying, with the help of Mr. Boltz. It is a pity bad weather was against him. I am going to an orchard above Nazareth to inspect for a farmer, who says he can not keep his fruit and is afraid he has the scale. If I find this to be the case, I shall get him to use the Lime-sulfur-salt Solution and show him how to make it.

I want to give you my experience with some other materials: Sulphate of Potassium is only good to check the scale, as my experience shows that Whale Oil Soap is better to check the scale, on certain kinds of trees, such as small trees. I still have the scale on rose bushes, but my small pear and quince trees are all right. I have had a great deal of experience.

Respectfully yours,
Harry Levers, Easton, Pa.

Following Northampton County persons have had good results with the Lime-sulfur-salt Wash: Simon Pysher, Peter Lenberger, Walter A. Landis, John Lerch, Prof. P. W. Shimer, H. B. Richards, W. H. Brotzman, Eugene Scott, N. H. Laros, J. L. Laybach, Theo. Gangaware, George Gangaware, F. M. Hower, Reuben Emery, E. B. Richards, H. C. Beitel, John Kolb, H. D. Updegrave, Niman Laros. S. L. Fisher, B. F. Caffery, J. K. Hower, C. C. March, D. D. Wagner, J. L. Lanbach, W. F. Beck, Cyrus Unangst, Peter M. Leidig, Levi Nicholas, A. O. Fritchey, H. B. Richards, L. M. Engler, John Schively, Victor Helms, T. J. Hartzell, Mrs. Preston Hartzell.

Northumberland County.

Inspectors: J. W. Battleyon, W. H. Brinkerhoff, Lees Cross Roads.
Number of Demonstrations, 18; Attendance, 330; Inspections, 484.

Testimonial:

Dr. J. G. Krebs and J. Deppen had good results from use of Lime-sulfur-salt Wash.

Perry County.

Inspector, T. C. Foster, Winfield, Pa.
Number of Demonstrations, 15; Attendance, 311; Inspections,276.

Testimonial:

P. F. Duncan and J. R. Lepperd report good results with Lime-sulfur Wash.

Philadelphia County.

Inspector, M. E. Shay, Tacony, Pa.
Number of Demonstrations, 3; Attendance, 54; Inspections, 427.

Testimonial:

Tacony, Pa., August 9, 1906.

"In making my inspections through Morton, Delaware Co., I called on Mr. Geo. B. L., where I held a demonstration last spring, and made an examination of his trees, and I am very glad to say that I found them free from scale, and Mr. L. is more than pleased with the results, as his trees were in a very bad condition. He had no idea of saving them, but is now thoroughly convinced that the Lime-sulfur Wash is all you represent it to be, and he would like me to call on him next fall for the benefit of his neighbors, if I can not find a more suitable place, I feel much pleased with the results of this particular job. I thought you would be glad to hear of this, as Mr. L's trees were in very bad shape, and there are others in the same state or condition. I also find almost every place touched with Blight."

M. E. Shay.

The following Philadelphia County persons have had good results with the Lime-sulfur-salt Wash: John Marsden, John T. Norris, Samuel W. Evans, Henry Bishop, Albert Whitaker, Wm. Burk, P. V. Jones, Fremont Bowman, Henry Morris, Thos. Dolan, Samuel Evans, H. W. Marsden, W. L. Greib, J. R. Rhoads, Sacred Heart Convent, August Clouser, John Adair, Jesse S. Garrett, W. H. Mattson, Don Wallengs, A. J. Pennock, F. P. Gaskill, T. H. Shoemaker, Tandall Morgan, G. F. Bodine, Gen. Russel Thayer, E. V. Dwight, Randal Dutton, Berthold Hevessy, Mrs Chas. W. Henery, Henry Otto, Walter R. Smith, Chas. Simons, Dennis Mahoney, D. S. Lindsay.

Pike County.

Inspectors, C. E. Plum, W. E. Perham, Niagara.
Number of Inspections, 33.

Potter County.

(Not yet inspected. No San José Scale known in Potter Co.).

Schuylkill County.

Inspectors: J. W. Battleyon, W. H. Brinkerhoff, Lees Cross Roads.
Number of Demonstrations, 4; Attendance, 80; Inspections, 300.

Testimonial:

"My apple orchards are faring better and, now that the Lime-sulfur wash is proving a success, I have taken on new hope. Have planted apple largely last spring and am just now receiving another shipment all for orchard purposes.

All trees that I sprayed thoroughly last spring with the Lime-sulfur are practically free, while those not covered with spray are covered with scale."

Yours truly,
J. E. Heine, Proprietor Prospect Fruit Farm.

H. W. Omler reports good results from Lime-sulfur Wash.

Snyder County.

Inspector: T. C. Foster, Winfield.
Number of Demonstrations, 14; Attendance, 320; Inspections, 672.

Testimonial:

"I 'dehorned' some of my peach trees last April, and then whitewashed them with Lime-sulfur-salt Wash, and it worked all right. If I had only dehorned about two thousand more and treated them in the same way, I would now have nice thrifty trees. I tell you that dehorning is a grand thing for peach trees, if done at the proper time. I merely experimented with it on a small number of trees, but I now think it is all right and we can kill the San José Scale on them. I first dehorned them and then painted the points where I sawed the branches off, using white paint. I then took a whitewash brush and put Lime-sulfur-salt (boiled) on in that way, being sure to touch every spot. I also did some spraying but not as much as I should have done. I experimented in both ways, with the sprayer and also with the brush. I can say that Lime-sulfur-salt is all right for the San José Scale, but most of the fruit growers in this part of the country neglect their trees too much. That was my experience, as I could have saved lots of trees if I had attended to them in time. I now say this—if a tree is in a pretty bad condition I would dehorn it and then apply the Lime-sulfur-salt, when you are sure to reach every spot, and also you will get a nice young head on your tree again. I think this expresses my experience in spraying."

J. A. Walter.

Following is a list of the names of persons in Snyder County who had good results with the Lime-sulfur Wash:

Dr. P. Herman, J. D. Wetzel, Benj. Zerbe, Robert Feese, C. M. Camp, Chas. Sanders, W. H. Bingaman, E. E. Wetzel, J. Herbster,

C. Felker, J. D. Herbst, J. A. Haines, C. Aigler, M. Gilbert, J. Aigler. Mrs. J. G. Snyder, C. L. Wetzel, C. E. Dresse.

Somerset County.

Inspector, H. H. Dutton.
Number of Inspections, 20.

Sullivan County.

Inspector, G. P. Stevens;
Number of Demonstrations, 1; Attendance, 35; Inspections, 45.

Susquehanna County.

Inspectors: W. B. Packard; C. E. Plum.
Number of Demonstrations, 1; Attendance, 8; Inspections, 66.

Testimonial:

To Mr. W. B. Packard, State Demonstrator:

Dear Sir: In reply to your question I would say that the trees which you sprayed have done very well. I am going to have all my fruit trees sprayed this autumn. I have determined to make an effort to save them and feel sure that it can be done. As you know Susquehanna is one of the best apple counties, and produces yearly a very large quantity. If the farmers do not adopt spraying soon, it is plain that it is only a question of time when the fruit trees will be wiped out. I can not tell you how glad I am that you visited our place last spring. Previous to that time I had wondered what made so many of the trees die, but since you taught me to recognize the scale, the cause is easily found, and if found in time can be eradicated. I am afraid that the farmers throughout the State will find out too late what a splendid effort the State authorities are making to help them to save their trees.

Wishing you every success in your work, I am,

Gratefully yours,

G. W. Norris.

Tioga County.

Inspector, W. B. Packard.
Number of Inspections, 167.

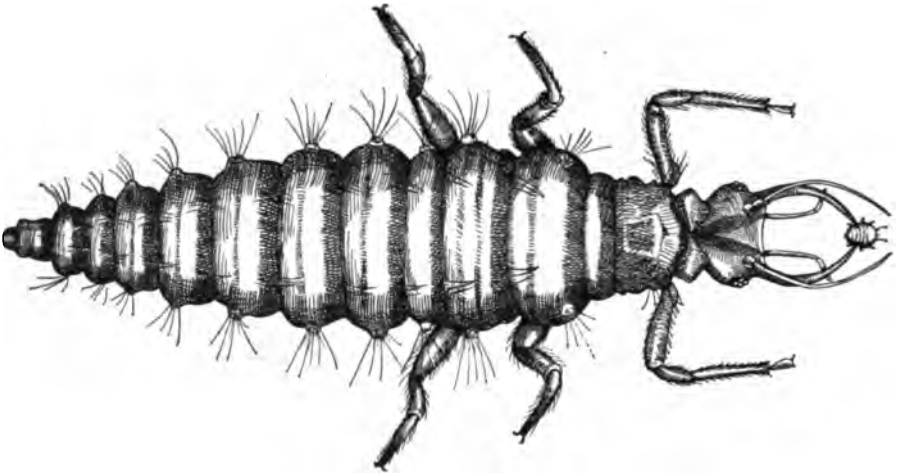
Union County.

Inspector, T. C. Foster, Winfield, Pa.
Number of Demonstrations, 15; Attendance, 213; Inspections, 1560.

PLATE LIX.

DOES SPRAYING PAY? About twelve bushels of sound apples and less than one-half bushel of wormy apples from one small tree, sprayed last spring with four ounces of Paris Green in fifty gallons of Bordeaux Mixture, just after the blossoms fell, and again ten days later. Photographed by the Economic Zoologist.

PLATE LX.



(a) Enemies of the San José Scale. Larva of the Lacewing Fly. (*Chrysopa sp.*) killing young San José Scale. Drawn from specimen No. 6028c in the office of the Economic Zoologist, by W. R. Walton, Artist.

(b) Fungus (*Cordyceps clavulata*) destroying peach scale or Lecanium (*Lecanium persicæ ?*) Drawn from specimen No. 4711 in the office of the Economic Zoologist, by W. R. Walton, Artist.

Testimonial:

Lewisburg, Pa., R. F. D. 3.

Prof. H. A. Surface, Economic Zoologist, Harrisburg, Pa.,

Dear Sir: "I would like to add my indorsement to the method you so ably champion of controlling the San José Scale. My experience in fighting it was first by using Target Brand, a preparation of 'soluble oil' sold by The Horticultural Distributing Company, of Martinsburg, W. Va., which I used the summer and fall of 1905, with very unsatisfactory results, as the scales seemed to thrive with it. Last spring I determined to try the Lime-sulfur-salt, which I did in my plum orchard, in which there were several young apple trees, about eight years old. The scale had injured my trees so badly that I feared they would not survive the summer. But when your representative, Mr. T. C. Foster came around, inspecting the orchards in this locality last summer, he took special interest in trying to locate if possible any live scale in the orchard. There appeared only a few on one limb of one apple tree. They were living but not in a very thrifty condition. So we agreed to have a demonstration held this fall in the orchard, and thus try to show others how to take care of their trees.

I must say that I am very much pleased with the way the demonstrations are conducted, and I believe it must result in much good to the fruit growers of the State."

G. W. Wolfe.

Reply:

Harrisburg, Pa.

Mr. Geo. W. Wolfe,

Dear Sir: I regret that I have been too busy to reply sooner to your most highly valued letter of recent date in which you state plainly the definite differences in results between the Target Brand preparation, which did not give you satisfaction, and the Lime-sulfur Wash which did. I am glad to know that the practical people are having the same results that I have had in my experiments, because it shows that I am not unjustly against the commercial insecticides, but I do not think it right for them to be advertised for more than their true value deserves, if I can help it. In other words, all that I desire is the truth, and your letter helps us in arriving at this. You will be surprised in learning that the commercial insecticide people have apparently formed a collusion and are doing what they can to suppress or annul my efforts in behalf of the fruit growers where I advocate the Lime-sulfur Wash.

I am glad to know that our demonstrator gave you the help you

needed, and hope that the Legislature will make provision for the continuation of this work. Please let me give you all possible assistance in the future.

Very truly yours,
H. A. SURFACE, Economic Zoologist.

Following is a list of names of persons having good results with the Lime-sulfur Wash in Union County:

J. G. Yocum, J. E. Dunkle, Abram Kauffman, Newton Newman, Dan'l Walter, A. G. Brown, J. A. Noll, Wm. Derr, E. C. Sheary, G. S. Flick, Rev. J. T. Judd, Abraham Brown.

Venango County.

Inspector, J. W. Cox, New Wilmington, Pa.
Number of Inspections, 174.

Warren County.

Inspector, F. Z. Hartzell, Harrisburg, Pa.
Number of Inspections, 550.

Testimonial:

Warren County was completely inspected and San José Scale was found on a few trees on two premises and exterminated by destroying the trees.

Washington County.

Inspectors: James Fergus, Elizabeth; W. S. Fisher, Harrisburg, Pa.
Number of Demonstrations, 3; Attendance, 110; Inspections, 89.

Testimonial:

Messrs. Edward Wallace and Robt. Sample of Washington County had good results with the use of the Lime-sulfur-salt Wash.

Wayne County.

Inspectors: C. E. Plum, W. E. Perham, Niagara, Pa.
Number of Inspections, 90.

Westmoreland County.

Inspector, James Fergus, Elizabeth, Pa.
Number of Demonstrations, 1; Attendance, 100; Inspections, 100.

Wyoming County.

Inspector, W. B. Packard.
Number of Demonstrations, 4; Attendance, 191; Inspections, 141.

Testimonial:

"My apple orchard which you looked at in November, 1905, and found in such bad condition, I have recently had examined with a microscope, and find the Oyster-shell and Scurfy Scales to be entirely dead, and only one tree infested with the San José Scale. I had the orchard sprayed twice during the winter with the Lime-and-sulfur Mixture. This is where you gave a demonstration showing the methods of making and applying the Lime-sulfur Mixture, before the Wyoming County Horticulture Association, and where the trees were so thoroughly infested that they were encrusted and most persons who saw them said they would die and it was then supposed to be useless to try to do anything with them. But they are now saved."

W. E. LITTLE.

Messrs. Edwin Stark, Chas. Trebal and Edward Stark of Wyoming County had good results from the use of the Lime-sulfur-salt Wash.

York County.

Inspector, D. C. Kauffman.

Number of Demonstrations, 24; Attendance, 254; Inspections, 881.

Testimonial:

Prof. H. A. Surface, Harrisburg, Pa.,

Dear Sir: "Your inspector visited my place during the summer, and he assured me that the spraying that I had done with the Lime-sulfur Wash on my trees early in the spring before the leaves appeared had been very effective, as he examined them closely at the time he was here. I shall continue the spraying this fall and next spring with the same material."

H. M. REBERT.

In an orchard of 3,600 peach trees, about six years old, Henry Lehman & Co., of Hellam, York county, cut down about half the trees. They sprayed the remaining 1,800 trees with the Lime-sulphur Wash and sold 1,500 bushels from those trees that were sprayed, and doubtless could have sold as many bushels this year had the other 1,800 trees been sprayed instead of having been chopped down.

Following is a list of the names of persons having good results with the Lime-sulfur-salt Wash in York County: C. F. Keech, J. F. Striebig, Wm. Cunaway, H. M. Rebert, J. H. Floyd, Morrett Hoover, C. R. Kopp, Zach Horner, Zach Gross, S. B. Hykes, Henry Lehman, Lehman & Co., Jacob Ihrig, James McDowell, Benj. Stoner, E. F. Kauffman, H. E. Taylor, J. A. Gates, D. E. Frey, C. Darone, N. E. Niles, A. Emenherser, David Horn, Jos. Loyd, C. C. Freck, R. H. Woltman, H. V. Waltersdorff, Jacob Hovis, Emanuel Hess, E. K. Meyers, Milton Martin, A. Kaltrirder, Samuel Hikes.

EARLY SPRING REMEDIES.

Certain applications are preventives of insects or plant diseases and must be applied in the early spring if at all. With plant diseases the important object should be to keep the plants from becoming diseased, because after the fungi or other disease germs enter the plant no fungicide can reach them or destroy them. Also in applying insecticides it is in many cases really necessary that they be applied while the insects are very young, and consequently much more easily killed, and in some cases, as in that of the Codling Moth, the application must be made before the pests find concealment if it is to have any desired effect whatever.

Club Root.—The Club Root of cabbage is due to a definite germ or organism which exists in the soil and may find its way to the plant either through the soil in which the seed are grown, or by means of the soil in which the plants are set. This is the disease which causes the root and stem of the cabbage to become very large and swollen, and reduces the energy of the plant so that the heads are not formed and the plant is ruined. It is sometimes called Big Root, Big Foot and Club Foot. After the plants are once diseased little can be done for them, but it may be of some value to use fertilizer and cultivate thoroughly to increase their vigor as much as possible. The proper procedure is to prevent the appearance of the disease by planting clean or uninfected plants in soil into which a small handfull of Sulphur and Lime has been stirred. Use Sulphur, one part, and Lime, twenty parts, well mixed together and applied in the soil in the hills or where the plants are to be set. This has also been recommended for preventing Sweet Potato Rot, but we have not yet had an opportunity to try it for this.

The Codling Moth.—The Codling Moth is the insect which causes the wormy apples, pears and quinces. While it is not always known by its common name, there is no doubt that all persons are familiar with its effects in eating the seeds and boring around the core of these fruits. The life history of this insect should be understood, in order to get at the one important point of combatting it successfully. It commences its existence as an egg laid on the very young fruit shortly after the blossoms fall. In a few days the young larva or "worm" hatches from this egg and generally crawls to the blossom end of the fruit and eats for a day or two at the surface within the points or tips of the calyx or green cup which surrounds the showy part of the flower and now tips the fruit. It next enters the fruit and feeds chiefly upon the seeds, but also excavates it at the core, and causes it to appear to ripen earlier, but in fact it generally falls prematurely, and of course, is second grade in quality. The larva becomes grown about the middle of the summer, and if

the fruit does not fall to the ground by that time, it bores its way out and climbs or falls to the ground or to the trunk of the tree, where it conceals itself beneath the bark or at some other place for protection. Here it makes a very thin cocoon, transforms to a small chrysalis within a short time, and again transform to a small gray moth, which flies to the fruit and lays eggs for the second brood of the Codling Moth. These are, of course, considerably increased in numbers if the first brood has not been reduced by proper remedies, and are the ones that are found in the apples, pears and quinces during the latter part of the summer or fall of the year. The worms or larvae escape from the fruit in the fall after having become full grown, and find concealment under pieces of bark on the trunk and branches of trees or in cracks or other places in or around the trunks. They spin delicate silken cocoons and remain as larvae in these during the winter and transform to chyrsalids or pupae in the early spring, and about the time the blossoms appear they come forth as winged moths ready again to lay their eggs on the young fruit.

Remedies for the Codling Moth should be applied shortly after the blossoms fall, but not while in bloom nor after the green parts of the calyx lobes come together. The remedy chiefly used is Paris Green, one part in one hundred and fifty gallons of water. Stir the Paris Green into a paste in a vessel with enough water to mix it, and then pour it into the water. Of course, this means one-third pound of Paris Green to a fifty-gallon spray tank. It is often advisable to use an equal amount of Lime with Paris Green to prevent burning the foliage, but all Paris Green does not demand this.

Arsenate of Lead is one of the best arsenical poisons to use for the Codling Moth, applying it in the proportion of two pounds of Lead Arsenate to fifty gallons of water. It stays well in solution, sticks to the fruit and leaves, poisons quickly, and does no injury to vegetation. The spraying should, of course, be thorough, and the liquid should be thrown in such manner as to reach within the calyx as much as possible. In about ten days spray again, and this will be all the spraying that will be necessary to insure fruit fairly free from infestation. If the spring brood of the Codling Moth is checked by thorough spraying the summer brood will not amount to much.

Plate 59 shows the relative difference of infested and uninfested apples after spraying twice last spring. There is less than one-half bushel of infested apples for about twelve bushels that are sound and clean.

Cabbage Root Worms.—For Cabbage Root Worms spread disks or paper pads of tarred paper in the centre where a hole can be punched with a stick about the size of a lead pencil, through which the plant can stand when the disk is placed tightly around it on the

top of the ground. Also it is probable that a handful of tobacco dust placed around the plant at the top of the ground when setting the same will prevent the fly from laying her eggs.

Canker Worms.—Spray for Canker Worms with arsenical poisons as soon as they hatch and commence feeding, using the formula mentioned above for the Codling Moth. The Canker Worms will be abundant this year again in some of the central and western counties of Pennsylvania, although in other counties like Beaver it will not be nearly so destructive, because its parasites have killed it there.

Cutworms.—Cutworms can be killed either with sweetened bran, using fifty parts mixed with one part of Paris Green, or by dipping bunches of clover into Paris Green water, which has been slightly sweetened, and putting them under the ground or under boards. Just after a rain go through the garden, truck patch or field and see where they have been exposed at the top of the soil and dig them out and kill them.

Tent Caterpillars.—It is not well to burn caterpillars from trees, as injury to the branches is liable to come from this. Fix a brush to the middle of a pole and put it in the nest and whirl it around and tear them down and plunge them into a bucket or pan of common coal oil. Some persons have been successfully shooting them out with a shotgun loaded only with powder.

Oat Smut.—Oat smut may be prevented by soaking the oats for a few minutes in a solution of formalin or formaldehyde, using one pint to fifteen gallons of water. Fill a barrel half full of the liquid, or in other words use one pint of formaldehyde and thirty gallons of water in a barrel, and put the oats in a sack so it will not float freely on top of the water and stand it in the barrel, moving it up and down until the water penetrates it entirely. Then leave it to drain and spread it on a hard surface like the ground or the barn floor, shovel it over occasionally to dry it, and proceed to sow or drill it. After it becomes dry enough to be free from water standing on the outside, the grain in drying can be hastened by dusting with air-slaked lime or plaster of paris.

Potato Scab.—Potato scab is the disease that causes the uneven spots like dry canker or dry rot in the potatoes and makes them look very unsightly. It finds its way into the field where the potatoes themselves are being planted or it may remain in the soil. It is, therefore, necessary to plant clean or treated potatoes in the soil where the scab has not before existed. It will do no good to treat the potatoes if they are to be planted in scabby soil.

They can be treated either with bichloride of mercury or with corrosive sublimate. While the latter is a deadly poison and must be kept away from metal to keep it from rusting, it can safely be used

by dissolving two ounces of the corrosive sublimate, which is mercuric bichloride, in two gallons of water and then diluted to fifteen gallons. Allow this to stand five or six hours, stirring it occasionally. Place the seed potatoes in this solution for an hour or more. This liquid can also be used for smut of oats, wheat and barley, the same as the formalin. Care should be taken, however, that nothing has an opportunity to eat potatoes or grain treated with it, and that the liquid be not poured where it will poison any creature.

We prefer to use the formalin in treating grain for smuts, and give the simple direction of soaking the seed for one or two hours in thirty gallons of water containing one pint of the formalin in solution. The liquid can be sprinkled well over the seeds or grain on the floor instead of immersing them in it if the sprinkling be preferred.

DO NOT SPRAY BLOSSOMS.

Occasinally we hear of persons spraying blossoms and are surprised to know that in this time of advanced knowledge concerning spraying and fruit growing any person who owns even a single tree would be so blind to his own interests as to attempt to spray that tree while in bloom. The first and primary reason for not spraying while in bloom is that the spray liquid is quite liable to fall upon the very delicate and tender pistle or central part of the flower and destroy it. Thus he would kill the fruit, just as would severe frost coming at the same time. If the person should anticipate a crop of fruit that would be entirely too heavy and should desire to thin it, he might use the spray pump to aid him in so doing, but this would be a very undesirable and inadvisable method of attempting to thin fruit.

The second reason for not spraying while in bloom is that by so doing the bees and other insects which are depended upon to carry pollen from flower to flower are liable to be killed by such spray. At the base of flower petals are nectar glands secreting nectar for the purpose of attracting insects of various kinds and their function in turn is to carry the yellow flower dust or pollen from one flower to another and thus insure cross fertilization. In many flowers there are conditions by which cross fertilization is entirely impossible, and no seed or fruit would be produced were it not for the agency of such insects as the bees. Thus even if a person be not a bee keeper, it becomes quite important for him as a fruit grower to preserve the bees that are flying about the blossoms of the fruit trees, and avoid any action that might destroy them.

The third reason for not spraying while in bloom is that there is nothing for which to spray at this particular time, and it is too early to spray for the codling moth, and there will be no decidedly beneficial results to come from spraying at such a time. It is by all means best to wait until after the petals or showy parts of the flower drop, and then spray with the Bordeaux mixture to which is added Paris green or arsenate of lead. The Bordeaux mixture is made by dissolving four pounds of bluestone or Sulphate of Copper in fifty gallons of water and adding six pounds of lime, slaked, and made into a milk of lime and strained. To this fifty gallons of the Bordeaux mixture add either one-third pound of Paris green or two pounds of arsenate of lead. Spray well over the trees just after the blossoms fall and you will kill the codling moth, which is the insect that causes the wormy apples, pears and quinces, and also the curculio, which punctures plums, cherries and other fruits. Repeat this spray in about ten days, and no other spray will be necessary for the codling moth.

NO EIGHTY THOUSAND DOLLAR "BUG BOOK."

Considerable comment has been created by the announcement through the press that this office is preparing a "Bug Book" or book on the insects of Pennsylvania to cost $80,000. It would seem useless to be obliged to deny such a ridiculous statement, but some persons have taken this seriously and have already written for the publication. The story originated by a reporter who came into the office and asked what would be some of the new features of our work. Among these was mentioned "A List of the Insects of Pennsylvania," as a very incidental or secondary feature, but he misunderstood the main points and magnified this one feature of a book on insects.

The facts of the case are that $40,000 per year have been set aside to meet the expenses of practically the entire outside work of this office, including salaries, expenses and materials for the experiments, investigations, much of the preparation of publications, inspections of private premises and also of nurseries, demonstrations, insecticides, apparatus, methods of combating destructive insects and preserving their enemies, making and preserving collections, making tests of insecticides, studying the enemies of insects, and disseminating information along this line. Some of the means of disseminating such information are (1) to acquaint the citizens of the Commonwealth with the insects which occur within its borders and (2) point out those which are obnoxious or

liable to become so, with dates and localities of their appearance, and remedies for preventing their destruction, and also (3) call attention to the insect friends of which thousands of species exist in this State, but which are far too little known and ignored. For this we have in mind the preparation of "A List of the Insects of Pennsylvania," with which will be connected different expert entomologists who are specialists in the various groups that may be assigned to them, but who will render their services without charge for the sake of aiding a work so important and practical, and in which they are greatly interested. Thus if the "Insect List" should be prepared its actual cost will not be one one-hundredth part of the amount that has been named for it, and no one will be made rich at the expense of the State, nor will any attempt be made to use the insects as an excuse to prepare another work to place in the category of the now famous "Pennsylvania Bird Book."

No one who knows of the real destruction by insects in this State and the importance of making a systematic study of them will say that the amount set aside for this work is as much as will really be needed, but we shall certainly be on a fair way to make a beginning and show possibilities by the results which within two years should lead to great things. It is now for all persons interested to begin to pull together, co-operating for the progress and advancement of the work here outlined.

A RETROSPECT.

A Review of Four Years as State Zoologist.

In closing this, the twelfth and last number of Volume IV of our Monthly Bulletins, and practically likewise our first term of service as the State Zoologist of Pennsylvania, we are justified in taking a retrospect of what has been accomplished that may be considered as justifying the effort that has been made by the State to maintain this work.

We should consider first the needs of our citizens, as the establishment of a State office should be for their benefit, and certainly not for that of any one or a very few individuals. Due to the increase in activity along the lines of importing new seeds and plants and in extending cultivation by destroying primative forests and woodlands, and also due to the longer continued cultivation of one kind of crop in one locality or on a large area, pests which have not previously been conspicuous are occasionally occurring as new and destructive enemies to the crops produced or to the property of mankind, especially of the husbandman.

We are liable at any time to receive importations of more destructive insects than any that at present infest any property of this State. Among such are the West India Peach Scale, the Brown Scale, the Gypsy Moth, the Brown-tailed Moth, and other pests which fortunately are not yet found in Pennsylvania. To prevent the occurrence of such creatures in our Commonwealth we have made a strenuous effort in the inspection of imported nursery stock and other shipments of plants and seeds, and have not only inspected our home nurseries to prevent the spread of scale from them, but have also inspected premises around nurseries and obliged owners to free them from such pests as the San José Scale, in order to keep the stock clean in our home nurseries.

The worst pest, of course, attacking the vegetation of this State is the San José Scale, which has been responsible for the destruction of millions of dollars worth of fruit trees, and which is causing an annual loss of hundreds of thousands of dollars in this State and reducing the output of fruit. In many of the large fruit growing districts two years ago nearly all of the fruit growers were discouraged and ready to quit, but by aid of this office they have been given new courage in practically every county of the Commonwealth and they are now producing almost perfect fruit, in spite of the presence of the San José Scale and other pests and are hold-

ing these pests in check by means of a simple, cheap and very efficient remedy which was scarcely known in this State four years ago, but which is now recognized by the practical fruit growers, and especially by careful scientific experimenters in nearly every State, as being the best and cheapest remedy for the San José Scale. Every day such testimonials are arriving at this office, and we know with certainty that hundreds of thousands of dollars worth of trees are now being saved by the application of this simple but efficient remedy, due mostly to the demonstrations and publications from this office. Of course there are occasionally unsatisfactory results, but these are almost always due to failure to follow instructions, and especially to lack of thoroughness in application.

Other pests have been studied carefully and the weak points in their habits have been exposed to the darts of men, which can pierce them in important points. Cutworms, Cabbage Root Worms, Peach Tree Borers, the Round-headed and Flat-headed Borer of Apple and Pear, Plant Lice, Household Pests, Mill and Granary Pests, the Codling Moth, the Curculio of Plum, Peach and Apple, Grape Pests, Potato Pests, the Hessian Fly and many other insects and plant diseases are among the important subjects of our investigations, experimentations and publications. Directions for the extermination or suppression of these have been published and used with satisfactory results. Upon all these topics and others we have definite testimony now on file in this office, showing that the citizens have used our information and saved their property.

We regret the necessity of depending upon the spray pump, yet while this necessity exists little else can be done. It would be better if the natural enemies of insects should hold them in check in this State, but until these enemies are known and properly preserved we cannot expect them to increase to any great or beneficial extent. For this reason we have made a special study of scores of different parasitic insects, birds, serpents and other reptiles and amphibians, as well as insectivorous mannals, such as bats and skunks. Upon the serpents of Pennsylvania we have published a Bulletin of which the full legal supply of 25,000 has been exhausted and hundreds of calls for it necessarily have been refused. It showed that all the serpents are more despised than is justifiable. Only two Pennsylvania species, the Copperhead and the Rattlesnake, are in the least venomous, and most of them are destroyers of insects and mice. The worst that can be said about a few of them is that they kill toads.

During the past four years this office has averaged nearly one and one-half pages of printed matter issued daily, besides at least fifty letters of correspondence further explaining subjects set forth in the Bulletins, or on other economic or scientific matters. These

Bulletins have been sent only to persons who have requested them, and no one has been turned away or refused at any time for any reason excepting reaching the legal limit of 25,000, which is the maximum number of copies permitted by law. No name has been dropped from the mailing list with intention excepting after having been notified at least twice that the list was to be revised for the sake of reducing it and that his name and address should be returned at once.

Service has been given to tens of thousands of citizens in the form of actual inspection of orchards, lawns and gardens to detect the kinds of pests present and give notification to the owners of their presence and methods of proper treatment. Much information has been disseminated at hundreds of public meetings, where demonstrations have been given, showing how to prepare and apply materials to destroy insect pests. On the whole, most employees of the office have been faithful and earnest in their desire to give the greatest amount of service during their engagement, and we have undisputable evidence of the gratification of the public. This means much and is exceedingly encouraging to a public official, who faithfully tries to do more than his mere duty. We cannot close this restrospect without calling attention of the agricultural public to the uniform support and encouragement our strenuous efforts have received from Governor Pennypacker and other State officers and Legislators, without which practically none of the results indicated above could have been achieved.

What the future has in store remains to be seen and developed. It is at present enough to say that the present Economic Zoologist has been reappointed under the new administration and remains at his post. A prospect, or "Forward View" of what we contemplate will be published in Volume V, No. 1, next month.

H. A. SURFACE,
Economic Zoologist.

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A PROSPECT OR FORWARD VIEW.

The term of four years for the present Economic Zoologist has come to an end, and he has been reappointed for a second term of the same duration. What this office has accomplished in the past our readers should already know. What it may accomplish in the near future depends upon us alone, but to a great extent upon the immediate and faithful co-operation of interested persons. We have no promise to make, beside that an endeavor to perform faithfully all duties that may be possible within the scope of this office. For successful results it is not only necessary that the work be done but that this reach the people who need help.

As a means of extending needed help to the public our Monthly Bulletin will be continued unless the burden should become too great to be carried. Certain lines of experimentation and investigation will be continued and the results will be published in the Bulletin. Inspections of orchards and nurseries will be continued and demonstrations of the methods of fighting all kinds of diseases and enemies of plants will be given whenever possible. If persons should wish demonstrations of the methods of spraying for any insect pest or disease of plants, they should make application either to this office or to the inspector and demonstrator in their respective districts. The State furnishes the apparatus and material without charge, and only asks the aid of the person who is to receive the direct benefits of the demonstration.

One new feature that will probably be undertaken will be to select an orchard of fair size in the central part of each fruit-growing district of the State and give it such treatment during the entire year as it may need to suppress the pests, and produce first class fruit. Nothing will be of greater benefit in drawing the attention of the public to the real benefits of caring for trees.

Our investigations of the enemies of insects will be continued, and Bulletins will be published upon these subjects. The mailing list will not be revised at this time, but the Bulletins will be continued to the persons who are now receiving them, and other names will be added, without charge, as they are received at this office. Specimens of insects, reptiles, etc., are requested, and reports of impending insect outbreaks are desired promptly. We make an earnest request for the help of the public in the service, which must be imperfect without it. All personal requests will be answered promptly and Bulletins mailed as near the first of the month for which they are dated as may be done in consideration of the great amount of work that is placed upon the State Printer.

Address all packages and communications to

H. A. SURFACE,
Harrisburg, Pa.

CALENDAR FOR 1907.

By H. A. Surface, State Zoologist.

FOR TREATING INSECT PESTS AND PLANT DISEASES.

PART I. FORMULAE AND METHODS.

I. A. Fungicides, for preventing diseases of plants.

1. Ammoniacal Solution of Copper Carbonate or Cupram.
2. Bordeaux Mixture.
   - (a) For dormant plants.
   - (b) For ordinary plants.
   - (c) For delicate plants.
3. Soda Bordeaux Mixture.
4. Copper Sulphate.
   - (a) Strong, for dormant trees.
   - (b) Dilute, for trees in foliage.
   - (c) Solution for smut, etc.
   - (d) For killing wild mustard.
5. Corrosive Sublimate, for plant diseases.
6. Formalin.
7. Iron Sulphate and Sulphuric Acid (Green Vitriol or Copperas)
8. Potassium Sulphide.
   - (a) Stock solution (Home made).
   - (b) Liver of Sulphur and Water.
9. Dust Spray.
10. Lime-sulphur-salt Wash.
11. Sulphur and Lime.
12. Cut and Burn Diseased Parts.

I. B. Insecticides, for Killing Insects.

Internal Insecticides, for Poisoning Chewing Insects.

13. Paris Green.
    - (a) Strong.
    - (b) Medium.
    - (c) Dilute.
14. London Purple.
15. White Arsenic.
16. Arsenate of Lead or Disparene.
17. Arsenite of Lime.
18. Arsenite of Soda.
19. Green Arsenoid, Green Arsenite, etc.
20. Poison Traps.
    - (a) Fresh Baits.
    - (b) Bran Mash.
    - (c) Criddle Mixture.
    - (d) For Household Pests.
21. Borax.
22. Plaster of Paris.
23. Hellebore.

Contact Applications, for killing Sucking Insects.

24. Kerosene.
25. Kerosene Emulsion.
    (a) Soap Emulsion.
    (b) Milk Emulsion.
    (c) Kerosene Emulsion with Pyrethrum, Sulphur, etc.
26. Kerosene Mixture.
    (a) Strong, for dormant plants.
    (b) Dilute, for plants in leaf.
27. (a) Benzine, (b) Gasolene and (c) Turpentine.
28. Carbolic Soap.
29. Carbolic Bisulphide.
    (a) In Air.
    (b) In Soil.
30. Corrosive Sublimate.
31. Creolin.
32. Crude Petroleum.
    (a) Strong, for Dormant plants.
    (b) Dilute, for plants in leaf.
33. Fish Oil.
34. Carbolic Emulsion.
35. Hydrocyanic Acid Gas, or Cyanide of Potassium.
36. Lime.
37. Lime-sulphur (California Mixture).
38. Lime-sulphur-Blue Stone (Oregon Mixture.)
39. Lime-sulphur-soda.
40. Kerosene-Lime (Limoid).
41. Potassium Sulphide (Liver of Sulphur).
42. Lye, Soda, Caustic Potash, etc.
43. Pyrethrum or Buhach.
44. Resin Soap.
45. Resin Wash.
46. Salt, etc.
47. Soap.
    (a) Ivory, laundry or soft soap.
    (b) Whale Oil soap.
    (c) Tak-a-nap.
48. Sulphur.
    (a) Dust.
    (b) In Water, etc.
49. Tobacco.
    (a) Dust or Dry.
    (b) Decoction.
50. Water.
    (a) Warm.
    (b) Hot.
51. Hand-picking, Clubbing, Jarring, etc.

Traps.

52. Bands of Cloth, etc.
53. Boards, Corn Cobs, etc., on the ground.
54. Hopper-dozers.

I. C. Combined Insecticides and Fungicides.
- 55. Bordeaux Mixture and Paris Green or Other Arsenites.
- 56. Dust Spray and Paris Green.

I. D. Adherents, for Making Fungicides or Insecticides Stick to Smooth Plants.
- 57. Resin Lime Mixture.
- 58. Soap.
- 59. Resin.
- 60. Syrup or Molasses.
- 61. Glue.
- 62. Flour.
- 63. Salt.

I. E. Practical Preventive Measures.

X. Farm Practice.
- 64. Rotation of Crops.
- 65. Selection of Good Stock or Seed.
- 66. Starting Plants Early and Setting Strong Plants.
- 67. Proper Dates of Farm Operations.
  - (a) Of Plowing.
  - (b) Of Planting.
  - (c) Of Cultivating.
  - (d) Of Harvesting.
- 68. Early Destruction of All Unused Parts of Plants.
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- 70. Clean Farming.
  - (a) Clearing Away Rubbish.
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- 71. Proper and Frequent Cultivation.
- 72. Draining Wet Land.
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- 74. Strengthening Trees by Pruning, Thinning Fruit, Fertilizing, etc.
- 75. Use of Quickly Acting Fertilizers for Infested Plants.
- 76. Killing Pests While Few in Numbers.
- 77. Planting Trap Crops to Catch and Destroy Pests.

XX. Mechanical Devices.
- 78. Protecting Plants by Nets, Boxes, etc.
- 79. Bands Around Trees for Climbing Insects.
- 80. Wrapping.
  - (a) Trees, for Borers, Mice, etc.
  - (b) Plants, for Cut Worms.
- 81. Painting.
  - (a) With Paint.
  - (b) With Soap.
- 82. Paper Pads or Disks Around Plants.
- 83. Impassable Barriers.
  - (a) Ditches, Furrows and Holes.
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XXX. Chemical Preventives or Repellants.
- 84. (a) Ashes, (b) Soot, (c) Dust, etc.
- 85. (a) Camphor, (b) Moth Balls, (c) Cedar Oil, (d) Heliotrope.

86. Fish Oil.
87. Kerosene.
Kerosene Sand.
88. Tar.
89. Lime.
90. Nitrate of Soda.
91. Turpentine.
XXXX. Vital Means.
92. Strengthening Crops by Fertilizing, Cultivating, Pruning, Thinning, Watering, Draining, etc.
93. Destroying Allies of Injurious Insects.
94. Preserving Beneficial Insects.
95. Preserving Insectivorous Reptiles, Birds and Mammals.

CALENDAR FOR 1907.

FOR TREATING INSECT PESTS AND PLANT DISEASES.

PART I. FORMULAE AND METHODS.

I. A. FUNGICIDES, FOR PREVENTING DISEASES OF PLANTS.

A fungicide is a preparation for preventing diseases of plants. As most of these diseases are due to fungi, these materials are consequently called fungicides. The following formulæ are not insecticides and should be used only for diseases, for which they are recommended, and not for insects. Many of them can be made to act as both fungicides and insecticides by the addition of the proper material (See I. C., "Combined Insecticides and Fungicides.")

1. Ammoniacal Solution of Copper Carbonate, or Cupram.

This fungicide is used in place of the Bordeaux Mixture when there is objection to the latter staining the fruit, flower or foliage.

Formula: Copper Carbonate, 5 ounces; Ammonia (26° Beaumé), 3 pints; water, 45 gallons.

Dissolve the Copper Carbonate in the ammonia. This may be kept any length of time in a closed bottle, and diluted to the required strength when ready for use. It loses strength when standing open. It leaves no stain or color.

2. Bordeaux Mixture.

Make a stock solution of Copper Sulphate by suspending the Copper Sulphate (Blue Vitrol) in a bag just below the surface of a vessel of water, or dissolve it in hot water, at the rate of one pound to a gallon of water. Do not put it in a metal vessel. Make also a stock solution of lime; use a quantity of good lime, slake slowly, and add water to make a thick milk of lime; allow to cool before using, and always keep the lime covered with water.

The operator should either use fresh lime and slake it with water and thus obtain the calcium hydrate, or make a stock of lime paste by slaking the lime dry in the ordinary manner, and at once add enough water to cover it. Keep it in a barrel or vat in the form of paste or putty. Dip this out and use it in regular proportions at any time, being careful that it is kept covered with water to exclude air. Air-slaked lime can not be used in any of the following formulae where the lime is to enter into a liquid, unless twice as much be taken as would be required in using the water-slaked.

(a) For dormant trees use: Copper Sulphate, 6 pounds; Lime, 6 pounds; water, 50 gallons.

(b) For most plants in foliage use: Copper Sulphate, 4 pounds; Lime, 4 or 5 pounds; water, 50 gallons.

(c) For delicate plants use: Copper Sulphate, 3 pounds; Lime, 6 pounds; water, 50 gallons.

If the lime be of good quality and the mixture be made as directed, there will be no burning of the foliage. However, it is always best to determine whether enough lime has been used by testing the mixture. Spray with it, but do not sprinkle.

"There are three simple tests which may be used. (1) Hold a clean, bright knife blade in the Bordeaux Mixture for at least one minute. If it become copper-plated more lime should be used. (2) Pour some of the Bordeaux Mixture into a shallow dish and, holding it up to the light, blow gently across its surface. If properly made a thin pellicle will form on the surface of the liquid. If this does not form more lime should be added. (3) Dissolve one ounce of ferro-cyanide of potassium in 5 or 6 ounces of water. Pour some of the Bordeaux Mixture into a white dish and add to it a few drops of the ferro-cyanide solution. If sufficient lime has been used no change will be noticed. If a brownish-red discoloration takes place more lime should be added."

3. Soda Bordeaux Mixture.

Copper Sulphate, 4 pounds; Commercial Caustic Soda or Soda Lye (sodium hydroxid), slightly, about 1 pound and 5 ounces by test-alkaline—according to strength, about 1 pound and 5 ounces by testing; water to make 50 gallons.

To use instead of ammoniacal copper carbonate, to act as a fungicide and leave no stain.

Warning.—In each case of change of grade or brand of commercial caustic soda it will be necessary to test the strength with litmus paper to keep a slight excess of soda or lye, as shown by turning red litmus blue. Keep the mixture well agitated.

4. Copper Sulphate—(Blue Vitrol or Blue Stone).

A solution of Copper Sulphate is used as a preventive of grain smuts. (See also Formalin, Corrosive Sublimate.) It may also be used as a spray in place of the Bordeaux Mixture.

(a) For dormant trees use: Copper Sulphate, 1 pound; water, 25 gallons.

(b) For trees in foliage use: Copper Sulphate, 1 pound; water, 250 gallons. (Not as desirable as Bordeaux).

(c) For oat or wheat smut:

Soak the seed 10 to 12 hours in a solution of one pound of Copper Sulphate to 25 gallons of water. Then put the seed for 5 or

10 minutes into lime water, made by slaking one pound lime and diluting to 10 gallons with water. The lime tends to prevent the Copper Sulphate from injuring the seed.

(d) For killing Mustard in oat fields in spring, spray when the Mustard is only a few inches tall with 10 pounds dissolved in 40 gallons water. (It is not recommended for all kinds of weeds).

5. Corrosive Sublimate.

Corrosive Sublimate is deadly poison to all animal life, and therefore care must be taken to prevent animals from eating the materials treated. It is used against potato scab and grain smuts. (See also Formalin).

For use dissolve two ounces of corrosive sublimate in two gallons of hot water; then dilute to 15 gallons; allow to stand 5 or 6 hours, agitating several times meanwhile. (Always use wooden or earthen vessels; never metallic).

(a) For Potato Scab.—Place the seed potatoes in a sack and immerse in this solution for 1 or two hours. Plant them before they become contaminated with stray spores of the scab that may be found on dirty floors of the barn, etc.

(b) For Smuts of Oats, Barley and Wheat.—The seed may either be soaked, as for potatoes "seed" or may be sprayed thoroughly with the solution. In either case the seed must not be kept wet long enough to heat. Oats should be enclosed in sacks so they can be immersed in the liquid, as otherwise they float.

6. Formalin.

This has been found to be the best remedy for potato scab and smuts.

(a) For Potato Scab.—Soak the seed potatoes for two hours in a solution of a one-half pint of formalin to 15 gallons of water.

(b) For Grain Smuts—Soak the seed one to two hours in a solution of 1 pound of formalin to 50 gallons of water, or pour or spray the liquid over the seed while shoveling it over on a floor to mix it. Put oats into sacks to immerse.

(c) For Onion Smut and Black Rot of Cabbage.—Soak the seed for one to two hours in a solution of one-half ounce Formalin to 1 gallon of water, then plant in uncontaminated soil.

7. Iron Sulphate and Sulphuric Acid.

Formula: Hot water, 100 parts; iron sulphate, as much as will dissolve; commercial sulphuric acid, 1 part.

Add the acid to the crystals and then pour on the water. This is a good fungicide for dormant grape vines attacked with anthracnose. Apply with sponge or brush.

8. Potassium Sulfid.

A stock solution is made as follows:

(a) Formula: Potash, 32 pounds; sulphur, finely ground, 37 pounds; salt, 2 pounds; water, 50 gallons.

The potash, sulphur and salt may be mixed together in a large metal tub with a little water; the chemical action will make it boil. For spraying on foliage dilute with 100 times as much water. It is used against the active stages of the red spider. Three applications at intervals of one week kills the eggs and moulting forms.

(b) A solution, which loses strength upon standing, is made by mixing one half to one ounce potassium sulfid (Liver of Sulphur) in one gallon of water. It is used against mildews of gooseberry, rose, carnations, violets, grapes, etc.

9. Dust Spray.

Sulphate of Copper, Powdered (Dry), 1 pound; Finely divided Dust, such as Slaked Lime or Flour, 20 pounds; Dust this over the plants when the leaves are moist, as with dew, or after a rain. When they are moist with dew in the evening or in the morning is a good time. (See No. 61).

10. Lime-sulphur Formula (No. 41). All preparations given of Lime sulphur Formulæ are first class fungicides, especially for Peach-leaf Curl when applied before the buds burst.

11. Sulphur and Lime.

Powdered Sulphur, 1 part; Lime, 20 to 40 parts.

Mixed in the soil in hills or furrows where cabbage is to be set to prevent Club Root, and where Sweet Potato plants are set this mixture is said to prevent Sweet Potato Rot.

12. Cut and Burn Diseased Parts.

Some plant diseases can not be met by any other means known at present than by cutting out and burning the diseased parts. Among these are Pear Blight, Twig Blight, and related diseases which are thought by many to be identical. Burn at once all trees with Peach Yellows, cabbage with Black Rot, etc.

Promptness in destroying diseased plants or parts of plants is essential in preventing the spread of disease, not only in the first year of its occurrence, but especially during the following year.

I. B. INSECTICIDES, FOR KILLING INSECTS.

Internal Insecticides, for Poisoning Chewing Insects.

13. Paris Green.

Arsenical insecticides are used to combat the various insects that chew the foliage and fruit. Although there are better arsenical in-

secticides, Paris Green is the most popular. Even the Paris Green from the best manufacturers contains at times a great deal of uncombined arsenic. Therefore, it is to be expected that some persons get better results from its use than others. Some will have the foliage burned very badly and others not at all. There is no reason why Paris Green should not be as effective as it was a few years ago, excepting that it is now often adulterated. In one of the neighboring States a great many samples of Paris Green were analyzed, and none that were purchased from the manufacturers were found adulterated, while several from dealers were so adulterated and diluted as to be ineffective when used according to standard formulæ.

To make a liquid spray of Paris Green, slake the lime gradually and sprinkle in the Paris Green, then add the rest of the water; or stir the Paris Green into the paste with enough water to make it pasty or mushy, in a smaller vessel, and then rinse it into the larger vessel containing the water. Always use at least twice as much lime as Paris Green in order to destroy the evil effects of the free acid that would burn the foliage.

(a) Strong Formula: Paris Green, 1 pound; Water, 75 to 100 gallons.

This is for very hardy plants, such as potatoes, and for insects that are especially hard to kill, such as Canker Worms.

(b) Medium or Ordinary Formula.

Paris Green, 1 pound; Fresh lime, 2 pounds; Water, 150 gallons:

This is the formula most generally used for nearly all plants, but for the tender kinds, it should be yet more dilute.

(c) Dilute formula for tender plants.

Paris Green, 1 pound; Fresh Lime, 2 to 4 pounds; Water, 200 to 300 gallons.

This is for such plants as the tender varieties of plums, like the Japanese, and also for peach, apricot, etc. It is not necessary to apply this or any other insecticide excepting when insects are present, or are likely to appear soon. There have never been any ascertained cases of persons being poisoned by the use of fruits or vegetables sprayed with arsenites, although it would not be best to spray shortly before picking or gathering the crop.

14. London Purple.

This is a common arsenical insecticide, although not used as much as formerly. It is a waste product in aniline dye manufacture. It is cheaper than Paris Green and is held in suspension in water longer, but the composition is very variable and more of the arsenic is in a soluble form than in Paris Green, therefore it is more dangerous to foliage, and is not highly recommended.

When used with three or four times as much lime it will be safe, and can be used in practically the same proportions as Paris Green.

15. White Arsenic.

Owing to the great amount of free acid which White Arsenic contains it can not be used alone upon foliage plants, but it is a valuable poison when mixed with flour or powdered sugar, or both, for certain insects like cockroaches, or for sprinkling on slices of potatoes for making poison bait traps.

White Arsenic, 1 part; flour, 20 parts; powdered sugar, 20 parts.

16. Arsenate of Lead or Disparene.

This is the least soluble of all the arsenical insecticides, and is, therefore, not liable to burn the foliage, even if used in large proportions. It is also quite adhesive, and is about the only arsenical poison that will stick to smooth plants without the addition of something to make it adhere.

Formula: Dissolve 11 ounces acetate of lead (sugar of lead) in 4 quarts of water in a wooden pail, and 4 ounces arsenate of soda (50 per cent. purity) in 2 quarts of water in another wooden pail. (The sugar of lead can be dissolved more quickly by using warm water.)

If only a small quantity of the arsenate of lead is required it can be purchased in the prepared paste or dust form, and 3 pounds used 50 gallons water.

The above solutions poured into 150 gallons of water are required for Codling Moth, Tent Caterpillars, etc.; while these solutions poured into only 25 gallons of water are required for the Elm Leaf Beetle.

Arsenate of lead may be used whenever Paris Green is recommended. Its trade name is "Disparene."

17. Arsenite of Lime.

Formula: White Arsenic, 1 pound; Freshly burned lime, 2 pounds; water, 1 gallon.

Boil together for 45 minutes. Keep the resulting product in a tight vessel.

One quart of this added to a barrel of water or Bordeaux Mixture is used against biting insects. However, in Oregon, especially, it very often burns the foliage.

18. Arsenite of Soda.

(Known as "Kedzie" formula).

Boil 2 pounds of white arsenic and 8 pounds of sal soda for fifteen minutes in 2 gallons of rain water. Put this in a jug and label "Poison." When ready to spray slake 2 pounds of lime and stir it into 40 gallons of water, adding a pint of the mixture from the jug.

The arsenic in a pint of this mixture is equivalent to 4 ounces of Paris Green, and may be used whenever Paris Green is recommended. This insecticide is used in preference to Arsenite of Lime, because in the Arsenite of Soda one is sure of all the arsenic being combined to become insoluble in water, and thus there is no danger of burning the foliage. Arsenite of Lime is cheaper ,but Arsenite of Soda is more reliable.

19. Green Arsenoid and Green Arsenite.

These insecticides are applied in the same manner as Paris Green. They contain no free acid, and are thus not so liable to burn the foliage. They cost less than Paris Green (12c to 15c per pound), and being finer remain in suspension longer. Dr. Marlatt, of the Division of Entomology, U. S. Department of Agriculture, says Green Arsenoid should replace Paris Green as an insecticide.

Avoid Paragrene, Scheele's Green, White Arsenoid (Barium Arsenite), and "Bug Death." All but the last named contain so much soluble acid as to injure the foliage, and the last is reported as worthless by experiment stations that have tested it, and our own experiments indicate the same.

20. Poison Traps.

(a) Fresh Baits. These are prepared by dipping slices of potatoes, apples, or bunches of damp or wet clover into solutions of arsenical poisons, or dusting them while wet with arsenical poisons and placing them around the plants to be protected, as for Climbing Cutworms, or just beneath the surface of the soil around the plants, as for Common Cutworms and Wire Worms, or beneath boards in gardens where Cutworms and Wire Worms occur.

(b) Bran mash.

Arsenic Formula: White Arsenic, 1 pound; Brown Sugar, 1 to 2 pounds; Bran, 6 to 10 pounds.

Mix thoroughly and then add water to make a wet, but not sloppy mash. Other arsenites can be used if White Arsenic be not obtainable. Increase the proportion of the poison according to the kind used.

It is used against Cutworms working in garden crops, at the rate of one teaspoonful at the base of each plant. It is also recommended to be put at evening in rows of corn where Cutworms and Wire-worms are likely to be numerous. With tender plants care should be taken lest heavy rains wash the poison against the stems and thus burn the plants.

(c) Criddle Mixture.

This mixture has met with great success in Manitoba as a remedy against grasshoppers.

Formula: Paris Green, 1 part; Salt, 2 parts; Horse manure, 100 parts (by measure).

Mix the Paris Green with the water; mix this through the horse manure and then add enough water to make a soft but not sloppy mash. If the horse manure be fresh the addition of the salt is not necessary. Use as the Bran Mash, i. e., simply scatter the mixture over the land where the "hoppers" are thickest. It is most effective when spread in hot, sunny weather.

(d) For Household Pests.

Borax, white arsenic, powdered sugar and flour, equal parts are recommended for cockroaches, and a small quantity of white arsenic baked with cake dough makes a very good "home-made" rat biscuit, which has been known to be successful. This should be guarded with care from being used accidentally as food.

21. Borax.

For cockroaches spread powdered borax on bread, sweet potatoes or banana peelings, or mix with sweetened chocolate and place the bait where the roaches can get it. See Turpentine, etc. Use borax freely about sink, wainscoting, etc.

22. Plaster of Paris.

Plaster of Paris, 1 part; Powdered Sugar, 1 or 2 parts.

This has been used as an internal insecticide for cockroaches especially. The insects are said to eat the mixture, which will form an insoluble and indigestible mass in their digestive tracts and thus kill them. It is also said to kill mice and rats, but we have not been able to give it a test before this writing.

23. Hellebore.

This is an internal poison for insects, but not for man. It is used in place of Paris Green in the case of cauliflower or cabbage when there is danger of poison remaining on the part to be eaten. Hellebore is not poisonous to man, and so can be handled with impunity.

For Currant Worms—Sprinkle the dry hellebore on the leaves, on the under side when possible, when the dew is on, or after the leaves have been sprinkled with water, to insure its sticking.

Hellebore may be made into a decoction by using 1 ounce in from 1 to 3 gallons of water and applying it as a spray to poison insects where arsenites would be objectionable, as upon leaves to be eaten or on ripening fruits, and especially upon currants and gooseberries.

One part can be mixed with 5 to 10 parts of a cheap grade of flour and kept over night in a closed vessel, when all will be equally efficient as a powder.

CONTACT APPLICATIONS FOR KILLING SUCKING INSECTS.

The contact insecticides are chiefly for the suctorial insects, because these can not eat the internal poisons and consequently can not be killed by them, although the insecticides mentioned in this group will also kill most biting and chewing insects with which they come in contact. It is necessary for the contact insecticide to touch the insect, and if the latter be so protected, as by growing leaves or otherwise, that it is not touched by the application, the same does no good. For this reason it becomes necessary to apply such materials early before the leaves become large, abundant or deformed.

24. Kerosene.

Pure kerosene if properly applied may be used on pear trees in winter without great danger to the trees, but 40 per cent. kerosene is almost as destructive to insects, and may be used on apple and pear trees in winter without danger. Under no circumstances, however, is pure kerosene recommended to be used on active plant life of any kind. It has been used undiluted on plants dormant and in foliage (apple, pear and others) without apparent injury, but there are too many uncertainties attending its use to warrant its recommendation.

For pure sprays always purchase the 150 degree fire test kerosene.

For Cockroaches and other Household Pests.—With an atomizer spray into the cracks, etc., where the roaches are located.

For Mosquitoes.—Kill the larvae or wrigglers in water by putting one teaspoonful of kerosene on each square yard of water area.

25. Kerosene Emulsion.

This, probably, is the best form into which kerosene can be put in order to obtain the best results. When the kerosene is in an emulsion the proportion of kerosene is known to a certainty, while with the Kero-water sprays the proportion is not always just what one expects.

A stock emulsion is made as follows:

(a) Soap Emulsion.

Hard soap, shaved fine one-half pound; Kerosene, 2 gallons; Water, 1 gallon.

Dissolve the soap in boiling water; remove from the stove and add the kerosene while the water is still boiling hot; churn with a spray-pump until it gets to a soft, butter-like mass. Keep this for a stock mass.

For plant Lice and young scale insects use 1 part of the stock to 10 parts of water. Some insects will require a much stronger mixture.

(b) Milk Emulsion.

Plate I. Root Worm of Cabbage and Radish. (*Pnorbia brassicæ*), infesting Radish. Photographed in the office of the Economic Zoologist, from specimens collected near Harrisburg, Pa.
(See *Monthly Bulletin*, Vol. IV, p. 394.)

Plate II. Field infested with Root Worm (*Phorbia brassicæ*), showing Cabbage and Cauliflower, untreated. Many of the plants apparently vigorous died after the photo was made. By D. K. McMillan of the office of the Economic Zoologist.

(See p. 394, Vol. IV, *Monthly Bulletin of the Division of Zoology.*)

Plate III. Cabbage field, once in the same condition as that shown in Plate II, and photographed at the same time. Treated with Carbolic Emulsion and saved. Showing the results of our experiments.
(See *Monthly Bulletin*, Vol. IV, p. 387.)

When small quantities of emulsion are wanted it is often less trouble to make it with milk than with the soap and water.

Sour Milk, 1 gallon; Kerosene, 2 gallons.

Dilute as in preceding. If the milk be sweet add a little vinegar.

(c) Kerosene Emulsion with Pyrethrum, Sulphur, etc.

The insecticidal value of Kerosene Emulsion made by either of the above formulæ is increased by the addition of Pyrethrum, Hellebore, Tobacco, Sulphur, or any other powdered contact insecticide. It is particularly more valuable against Red Mites or Spiders when an ounce of powdered sulphur is added to each gallon of the material used as a spray.

26. Kerosene Mixture.

By using a Kero-Water Spray Pump or other spray pump made for the purpose of mixing kerosene and water at the time of spraying, a very good substitute for Kerosene Emulsion is obtained with no further trouble than to place the kerosene in one vessel and water with which it is to be mixed in another. It is to be applied according to one of the two general formulæ, as follows:

(a) Strong, for dormant trees.

Apple and pear will not be injured with Kerosene Mixture as strong as 50 per cent., while plum is likely to be injured if it be stronger than 40 per cent., and peach, even though dormant, with more than 20 per cent. Thirty-five per cent. Kerosene Mixture is about the weakest that will kill the scale during the dormant season.

(b) Dilute, for plants in leaf:

Kerosene, 1 part; Water, 10 parts.

This will not injure the foliage of any fruit trees or garden plants if properly applied, but is as strong as should be given to peach. All injuries by oils will decrease by spraying upon a bright and windy day when the evaporation is hastened.

Experiments seem to indicate that, like crude petroleum, the safest time to apply is on a bright, windy day in early spring, just before the buds begin to swell, in the form of a very fine spray.

One part of kerosene to six parts of water can be used on many trees in foliage without injury, while plant lice are killed in a mixture as weak as 1 part of kerosene to 15 or 20 parts of water. For plant lice, therefore, 1 part of kerosene to 10 of water is probably the best proportion to use. This proportion will also kill young scales, and is a good summer spray for San José Scale, but must be repeated often.

27. Benzine, Gasolene and Turpentine.

These substances are used singly and undilute, as contact insecticides, where pests are not on green leaves or plants that would be injured.

They are especially valuable to spray or inject into cracks inhabited by cockroaches, bed bugs, flea larvæ, carpet beetles, etc., and will kill all insects with which they come into contact, which injure carpets, clothes, or other fabrics. To kill ants find their nest and pour one of these substances into it in abundance.

We have examined an insecticide sold in this State and recommended to kill household pests of all kinds, scale insects, etc., and have found it to be nothing but benzine colored pink with a red vegetable extract, such as juice from red cabbage or beets.

28. Carbolic Soap.

Soft Soap, 2 pounds; Rain water, to thin like paint; Carbolic Acid (crude), 1 ounce. Apply to the bark of trees, twigs, etc., but not on the leaves.

There is a commercial carbolic soap that is not so strong, and is recommended for scrubbing pet animals and live stock for parasites, such as lice, fleas, etc.

29. Carbon Bisulphide, or Bisulphide of Carbon.

(a) For Insects in the Air.

This substance is used against a number of insects, and also other animals, which cannot be combatted with internal or even contact poisons. This liquid volatilizes very rapidly, and the gas being heavier than air, must be generated from above. It is used with good success against ants, buffalo or carpet beetles, clothes moths, museum pests, grain insects, woodchucks, prairie dogs, etc.

For the Buffalo Beetle.—A very strong percentage of the Carbon Bisulphide must be used to enable the fumes to penetrate into the body of the rugs, carpets, etc., where the insects are.

For Insects in Stored Grain.—Use one pound of Carbon Bisulphide to each 1,000 cubic ft. open space, or 100 bu. grain. Place the liquid in a shallow dish on the top of the grain; close the bin tightly and leave for twenty-four hours.

CAUTION: Keep lights of all kinds away where using.

For Borers in Trees—Inject a few drops of this liquid into their holes, and plug them with mud, putty, or grafting wax.

(b) For Insects in the Soil.

For Ants—First find the ant hill, then with a cane make several holes ten to twelve inches deep, into each of which pour 3 to 5 tablespoonfuls of Carbon Bisulphide. Cover the ant hill with an old blanket or burlap, preferably moist, to keep in the fumes, and leave twenty-four hours. Sometimes more than one treatment is necessary.

For Pests on the Roots of Plants, Grasses, etc.—Make holes in the soil to the depth of the pests and pour one or two tablespoonfuls of Carbon Bisulphide into each and close it at once by packing damp

earth into it with the foot. In loose sandy or loamy soil make three holes in each square yard, and in compact or "heavy" clay soil make four.

Where the gas is to rise through the air, as in fumigating nursery stock or dwelling houses, Hydrocyanic Acid Gas is to be preferred.

30. Corrosive Sublimate, for Insects.

Corrosive Sublimate is deadly poison to all animal life, and therefore care must be taken to prevent animals from eating the materials treated. It is used against potato scab and grain smuts. (See also Formalin).

For Bedbugs—A mixture of Corrosive Sublimate, one ounce; Alcohol, one-half pint; Turpentine, one-fourth pint, sprayed in all cracks and crevices where bugs might lodge, will effectually rid a house of the pests. More than one dose will probably be necessary. This is a good contact poison and also repellant.

31. Creolin.

Commercial Creolin is a blackish brown liquid, costing about twenty-five cents a pint. This is highly recommended for dog fleas, which sometimes become very annoying pests in dwelling houses. As the cat and dog are the source of the pest, these animals must be rid of the insects. The animals should be washed thoroughly with a mixture of creolin and water. For dogs a three per cent. solution should be used, or nearly four tablespoonfuls to a gallon of water; for cats a two per cent. solution, or about two tablespoonfuls of creolin to a gallon of water. Get the creolin well mixed with the water before using.

32. Crude Petroleum.

(a) Strong, for dormant plants.

"Crude Petroleum is an oily, inflammable liquid, varying in color from very dark brown to greenish tints. By refining it yields a number of valuable products, including paraffin, lubricating and illuminating oils and a series of highly volatile oils. It is the heavier oils that make it especially valuable as an insecticide. Crude Petroleum varies in appearance and composition according to the locality from which it is taken. The eastern oils are said to vary greatly from the western and most foreign oils, the former having a paraffin and the latter an asphalt base. The true indication of the safety of petroleum as an insecticide evidently depends upon its specific gravity; as it has been found that petroleum having a specific gravity of 43 degrees or above (Baumé oil scale at a temperature of 60 degrees F.) is less likely to injure the trees than petroleum, of a lower specific gravity, although oils of a lower specific gravity have been success-

fully used in some instances, notably in Canada." (N. Y. State Bul. 202, 1901.)

This is one of the best scale insect remedies. It should be applied on a bright, sunny day in early spring, and must be applied thoroughly and evenly; avoid over-drenching.

On perfectly dormant apple trees a 40 per cent. emulsion is used; on perfectly dormant plum trees a 25 per cent. emulsion is used, and on dormant peach trees not over 20 per cent; and on dormant pear trees 100 per cent., or undiluted Crude Petroleum can be used successfully for Scale Insects, without injury to the trees.

(b) Dilute, for plants in leaf.

Crude Petroleum or "Rock Oil" can be diluted by making into an emulsion or by applying as a mixture with water by using apparatus made for mixing. Use the same percentages and methods as in emulsifying or mixing kerosene or refined lamp oil.

It is not necessary to select oil of a certain known specific gravity if it is to be applied dilute. Crude Petroleum can not be used in making the Kerosene-Lime Mixture (No. 45), as it forms masses that will not pass through the nozzle.

33. Fish Oil.

Fish Oil is really the basis in the manufacture of Whale Oil Soap instead of Whale Oil for the useful insecticide that bears its name. It is also valuable in killing parasites on domestic animals by rubbing them with it. It is also the basis of a valuable repellant for keeping flies from horses and cattle, which is made as follows:

Fish Oil, 100 parts; Oil of Tar, 50 parts; Crude Carbolic Acid, one part.

Mix or shake these well together and apply as a spray or mist by means of a hand spray pump.

34. Carbolic Emulsion.

One pound of hard soap, one gallon of hot or boiling water, one pint crude carbolic acid.

Shave the soap and dissolve in the hot water, pour in the carbolic acid and churn or beat into a creamy emulsion.

Use one part of the emulsion to 30 parts water. It can be applied as a spray for plant lice or poured on ground around plants, using from a few spoonsful to a half pint on each plant.

This formula has been recommended as a remedy for the cabbage root worm, but experiments made recently by this office show that one part of the emulsion in 30 parts of water did not kill the pests unless it came directly in contact with them and remained so for a few minutes. One part in fifteen parts of water was more effective and the plants were apparently uninjured by the emulsion on exam-

ination four days after the application. It did not kill all the larvæ even at this strength. Its greatest merit perhaps lies in its action as a repellant in preventing the flies from laying their eggs. To be effective it should be applied before the larvæ attack the plants.

35. Hydrocyanic Acid Gas.

It is fully recognized that fumigation with hydrocyanic acid gas is one of the best methods of combating scale and other insects. For this reason many large nurseries in the region infested with San José Scale fumigate all their nursery stock before shipment. The laws of some countries require this, while no nursery stock, except evergreens, can be shipped into Canada without first being fumigated with this gas at the port of entry. All nursery stock liable to infestation by San José Scale must be fumigated before being brought into Pennsylvania. The gas is now used in greenhouses, granaries, mills and other buildings subject to infestation by insects or objectionable animals of any kind. The gas is a deadly poison to all animal life and great care must be taken in generating it. Unless thoroughly acquainted with its use, the entomologist or some competent authority should be consulted before handling.

The chemicals used in the production of the gas must be very accurately determined. The formula per 100 cubic feet of space usually used is:

Potassium cyanide (98 per cent.), 25 grammes (about one ounce); Sulphuric acid (1.83 sp. gr.), one-half more acid, liquid measure than cyanide (about two ounces); Water, twice as much water, liquid measure, as acid (about four ounces).

One of our Monthly Bulletins to be issued in the near future will contain a full account of the methods of generating and using Hydrocyanic Acid Gas for various purposes, including nursery stock and also household pests.

36. Lime.

Lime is of little if any value as an insecticide, being simply a deterrent and irritant. It can be used wet or dry on foliage without harm. When dusted on pear slugs or other tree-slugs or the larvæ of Asparagus Beetles it prevents them from doing much damage.

It is used to prevent Sun Scald by making a coating on the body of the tree in early spring. To increase the adhesive power make according to the following formula:

Skim milk, six gallons; Water, thirty gallons; Lime, sixty pounds; Salt, ten pounds. (Can. Expr. Farm Rpt., 1900.)

A path or band of air-slaked lime around a plant bed keeps it free from slugs and snails.

37. Lime-sulphur (California Mixture).

Sulphur (either Flour or Flowers), seventeen pounds; Quick Lime (or Fresh Lime), twenty-two pounds; Water, fifty gallons.

Slake the Lime finely, add Sulphur while slaking; cover with water and boil briskly for an hour. Add water to make fifty gallons and apply as a wash or spray while warm. It is not necessary to use it boiling hot, and the only reason for applying it warm is that it then runs better through the nozzle. (See our previous Bulletins for detailed directions.)

This was formerly made with salt, which is now proven unnecessary.

This certainly is the best and cheapest insecticide to be recommended for Scale Insects, Peach Leaf Curl, etc. It must be used when the trees are dormant, when it will not harm any kind, and can not be applied too strong nor too freely.

This is the cheapest good remedy for the San José Scale, that is known, and as far as we know at present is the best to recommend in extensive orchards.

38. Lime, Sulphur, Blue Stone (Oregon Mixture).

The proportions of the Lime, Sulphur and Blue Stone in this Wash are the same as for the Lime-sulphur-salt Wash in the following: Some persons recommend only one and one-half pounds of Blue Stone, while others recommend several times as much. This mixture is not to be highly recommended for the reason that the fungicidal value is not greatly increased by Blue Stone, as the Lime-sulphur Washes, when properly made, are both insecticides and fungicides without the necessity of adding additional material. It was formerly supposed that the addition of Blue Stone greatly increased the fungicidal value of this wash, but this has not been proven to be true by experiment, while it does unduly increase the expense.

39. Lime-sulphur-soda Wash.

Caustic Soda, five pounds; Flowers of Sulphur, twenty pounds; Quick Lime, twenty-five to thirty pounds; water, fifty gallons.

This is to be recommended as an unboiled Lime-sulphur Wash, and to be effective must be made with great care. For details of the process of making this, see pages 208 and 296 of Volume II of the Monthly Bulletin of the Division of Zoology.

This fully takes the place of the boiled Lime and Sulphur Washes, as it is both fungicidal and insecticidal in action, although it is more expensive when extensively used. It is to be recommended for use on a few trees or in small orchards.

40. Kerosene-Lime.

Kerosene, 1 gallon; Freshly Slaked Lime, 4 pounds; Water, 10 gallons.

This will make a mixture containing 10 per cent. Kerosene. For 20 per cent. Kerosene, as on dormant trees, use one-half the amount of water, and for a 5 per cent. Kerosene and Lime, as for plant lice and young scale insects, use twice the amount of water.

This is practically the mixture that has been advertised considerably as Limoid and Kerosene. The Limoid is a commercial product, and this name is given to a particular brand of magnesium lime from a particular kiln. The Kerosene-Lime has not yet been fully tried for scale insects and other suctorial insects, but we are now experimenting with it, and shall be able within a few weeks to discuss its merits. Its adhesiveness can be increased by the addition of Resin Soap or Resin Lime Mixture.

41. Potassium Sulphide (Liver of Sulphur).

This was mentioned as a fungicide (No. 11), and formula 11a, made with 50 gallons of water, is also a valuable insecticide to use on a few dormant trees for scale insects, etc. It is also recommended as a good insecticide against San José Scale when made as follows:

Potassium Sulphide, 1 pound; Lime, fresh, 1 pound; Water, warm, 2 gallons.

Mix and apply as a spray, or as a wash with a brush, when trees are dormant, or paint on the bark at any time. This is an easily-made substitute for the lime-sulphur washes, but more expensive.

42. Lye, Soda, Caustic Potash, etc.

These are in popular favor, but experiments show them to be of not much use. When trees are dormant one pound of lye to three gallons of water may be used on the limbs of the trees. For trees in foliage, one pound to forty gallons of water, but this will kill only the very tender insects, and stronger than this will burn the foliage.

These substances are valuable to destroy the Peach tree borer when used as follows:

Lye, Caustic Soda or Potash, 1 pound; Hot Water, 20 gallons.

Pour a quart of this mixture, while hot, around the base of each infested peach tree. Stir in any fertilizer that one may wish to add.

43. Pyrethrum.

This is the ground-up flowers of the Pyrethrum plant. It loses strength unless kept in a tight can or jar. When burned in a room it will destroy mosquitoes, flies, fleas, cockroaches, etc. It may be used as a spray, 100 grains of powder to two gallons of water.

44. Resin Soap.

This substance may be used against plant lice and other soft-bodied sucking insects. It may also be used, like the preceding sub-

stance, with Paris Green or Bordeaux, to make these stick to glossy surfaces.

Resin, 2 pounds; Caustic soda, 1 pound; Tallow, 1 pound.

Dissolve the soda in 1½ gallons of water; then add resin and tallow and dissolve them by applying a moderate degree of heat; add water enough to make 3 gallons.

Before using, dilute 1 pint of soap with 16 pints of water. This is a summer wash.

45. Resin Wash.

Resin, 20 pounds; Concentrated lye, 4 pounds; Fish oil, 2½ pints; Water, 100 gallons.

Place the resin, lye and oil in a kettle with sufficient water to cover them to a depth of 3 or 4 inches. Boil about 2 hours, making additions of water, until the compound looks like very black coffee. Dilute to one-third the final bulk with hot water or with cold added slowly over the fire, making a stock solution that must be diluted to 100 gallons when ready for use. This is a winter wash.

46. Salt, Nitrate of Soda, etc.

These are good to use against certain pests, such as root lice and root "worms." For example, a remedy that has been highly recommended to destroy root maggots of cabbage, cauliflower, etc., is a thimbleful of salt poured on the roots of the growing plants beside the stalk.

47. Soaps.

(a) Ivory or Common Laundry or Soft Soap.

This is quite valuable as a contact insecticide.

Use Ivory soap (10c size), 1 bar; Water, 15 gallons.

Apply warm, as it thickens on cooling. It is recommended for Rose Mildew, "Red Spider," Plant Lice, Mealy Bugs on household plants, etc.

(b) Whale Oil Soap.

This is good in combatting scale insects in family orchards or in old commercial orchards. It is too expensive, however, for general use.

For the winter spraying of scales use:

Two pounds of the soap to each gallon of boiling water.

This is doubtless the best insecticide to be used as a paint or wash applied upon the bark during the spring and summer. It should be kept from the foliage and young shoots, but will not injure the bark, yet only one application should be made in any one season. All portions of the bark should be covered.

For pear slug use:

One-half pound to 1 gallon of water.

For plant lice use:

One pound to 8 or 10 gallons of water.

This dilute solution may be used either as a spray or as a wash into which the twigs and leaves infested with plant lice and young scale insects may be dipped by bending them over into a pan containing the material.

(c) Tak-a-Nap Soap.

This is a new proprietary soft soap with which one can easily make a very good kerosene emulsion by merely pouring the proper amount of kerosene to make the desired percentage of emulsion into the suds or aqueous solution of the soap and stirring it violently or forcing it around through the pump for a few minutes.

48. Sulphur.

(a) Dry, for pests on leaves:

Sulphur, 1 part; Flour or slaked lime, about 9 parts.

Apply as a dust, especially when the leaves are damp, for mites, slugs, currant worms, etc.

(b) In Liquid.

Sulphur, 1 ounce; Water or soap solution, 1 gallon.

Apply as a spray for mites or "red spiders," and some other pests on house plants.

49. Tobacco.

This is a very important contact insecticide. In the form of a fine dust it is excellent for bearing trees affected with root lice; two-thirds inch of surface of earth is taken away from around the tree and 1½ to 2 pounds of dust is evenly scattered over the surface and afterwards covered with earth. The first application should be made in June, and if necessary repeated in August. It may also be used in the form of dry stems against root lice by applying it in the same way as the dust.

As a decoction of the leaves or stems it may be used as a spray against plant lice; or first spray with water and then sprinkle with the dust. Use tobacco leaves or stems, 1 pound; water, 2 gallons, steep or boil. Its efficiency is increased by adding one ounce of pyrethrum.

The decoction is also good to kill lice on cattle.

Tobacco smoke, when generated in an enclosed space, is fairly successful in combatting plant lice, as in greenhouses.

50. Water.

(a) Warm.

Warm water may be used as an insecticide, as in soaking peas and beans in tepid water for a few hours before planting them to kill the infesting weevils.

(b) Hot.

Hot water, or steam, may be valuable in certain cases. One of the best means of treating house plants for the numerous pests that infest them is to hold them in steam of a teakettle a few inches from the spout, where it is as hot as the hand can be held.

Plant lice dipped in hot water are killed at once. Into a wash boiler of water as hot as the hand can bear dip infested house plants for a few minutes. Nearly all kinds of insects upon them will soon be killed, and with a little experience the operator will learn the greatest length of time that each variety can safely be submerged in water of a certain temperature.

Hot water is also used in killing Clothes Moths and other household insects in clothing that can be submerged in it.

One of the best means of treating Carpet Beetles is to spread a damp towel over the carpet at the spot where it is infested and by ironing this with a hot flat-iron drive the steam down through the carpet and thus kill the pests.

51. (a) Hand-picking.

Where insects are large enough to be seen plainly and can be reached without difficulty it is often advisable to destroy them by picking by hand, as with tomato worms, grape vine leaf-beetles, stinking squash bugs, tent-caterpillars, eggs of canker worms on small trees, etc.

(b) Jarring.

For insects that are difficult to treat by other means and will drop suddenly when disturbed, as the Curculios, there is no better known means of treatment than to place a sheet or blanket under a tree and jar it severely with a few strong raps by a heavy, padded mallet. Then shake the fallen material into a pan of oil on water. A Curculio catcher is made by mounting a sheet on a wheel-barrow.

(c) Shooting.

A standard remedy for such insects as the Tent-caterpillar in many parts of Pennsylvania is to load a muzzle-loading shot gun (no choke bore), with black powder and a paper wad and shoot the nests or tents out of the trees.

(d) Burning.

Fire is a certain and safe means of destroying pests wherever they occur in parts of plants that can be burned. It is much better to sacrifice a stunted and badly-infested plant than to expose others to infestation from its pests. Always burn all parts possible.

(e) Cutting out.

One of the most unsatisfactory means of treating certain pests, such as borers, is to cut them out. This should not be necessary, because proper preventive measures (No. 86) should prevent them

entering the trees or plants. However when necessary to kill or remove borers try Carbon Bisulphide (No. 33) or Benzine (No. 31 a), or insert sharpened pliable wire into the hole and pierce the borer. In cutting, always cut lengthwise, not cross wise to the tree or vine, and cover the injured part with grafting wax to protect it. It is practical to cut borers out of squash vines by cutting lengthwise.

TRAPS.

52. Bands of Cloth, etc.

Certain insects, such as codling moths when preparing to pupate, climbing cutworms, etc., will conceal themselves under cloth or burlap bands placed around trees. Such bands should be put in place to serve as traps, and for codling moth larvæ they should be examined and the pests killed at least once per week.

53. Boards, Corn Cobs, etc., on the Ground.

On lawns and in gardens cutworms, crickets and false army worms, etc., will hide during the day time under boards which may have been placed flat on the ground or grass to attract or trap them. Stinking squash bugs and other pests in the garden can be caught by boards or corn cobs placed on the ground near the plants to be protected. The next morning drop the pests into a can of oil and water. We have trapped many by this means.

54. The Hopper-dozer for Grasshoppers.

The Hopper-dozer is a western invention, shaped something like a long dust-pan, with oil or tar in the pan, to be drawn across fields infested with grasshoppers to trap and kill them. Upon rare occasions we have known certain kinds of grasshoppers to become of sufficient local abundance in Pennsylvania as to demand such a trap.

I. C. COMBINED INSECTICIDES AND FUNGICIDES.

55. Bordeaux Mixture and Paris Green or Other Arsenites.

It is possible by combining Bordeaux Mixture or certain other fungicides with Paris Green or other arsenites to make a combined insecticide and fungicide. It does not really make much difference which fungicide or which arsenite is used, but Bordeaux Mixture with Paris Green added is the most common combination of this kind. Although it is generally not advisable to use such combined mixture upon fruits or crops that are about to be harvested on account of the supposed danger of poisoning them for the consumer. It is so easy to add Paris Green to Bordeaux Mixture and make both an insecticide and fungicide that we advise this whenever Bordeaux

Mixture is applied. On the other hand whenever spraying with Bordeaux Mixture, Paris Green and an excess of lime to equal twice the amount of the arsenite used should be added to the regular Bordeaux formula. We recommend this mixture for the Codling Moth, Leaf Spot, Apple Scab and various leaf-eating insects, applied as a spray shortly after the blossoms fall. Use 4 ounces of Paris Green or 1 gallon of Arsenate of Lead in 50 gallons of Bordeaux, according to the regular formula as though they were being used in water alone.

56. Dust Spray and Paris Green.

To the regular Dust Spray given in Formula 12 add 1 part of Paris Green to 40 parts of the Dust Mixture. Other arsenites can be added in the place of Paris Green if desired and if finely powdered.

I. D. ADHERENTS.

These are neither insecticides nor fungicides. They are simply materials for making insecticides and fungicides stick to smooth plants such as asparagus, cabbage, cale, cauliflower, kohl rabi, turnips, celery and onions. The desired insecticide or fungicide must be added to the adhesive mixture.

57. Resin Lime Mixture.

Pulverized Resin, 5 pounds; Concentrated Lye, 1 pound; Fish Oil or other animal oil, 1 pint; Water, 5 gallons.

Place the oil, resin and one gallon of water in an iron kettle and heat until resin softens. Then add the lye and stir thoroughly. Now add four gallons of hot water, and boil until a little of the mixture when dropped into cold water will mix with it, and give a clear amber colored liquid. Add water to make up for evaporation and make the entire mixture 5 gallons. Keep this as a stock solution, and add two or three gallons to each barrel of liquid spray, whether it be Bordeaux Mixture or Paris Green and water or other liquid. The material known as Bordeaux Resin is nothing more than Bordeaux Mixture made by the regular formula with two gallons of this stock solution added to each barrel.

58. Soap.

Soap is used to make spray liquids adhere to such smooth plants as those mentioned above, adding one pound to from ten to fifty gallons of the spray liquid.

James Good, No. 941, N. Front Street, Philadelphia, Pa., has made, according to a formula advocated by the U. S. Department of Agriculture, an adhesive soap, which can be bought and used with great success for this purpose. It is similar to No. 62.

59. Resin.

Resin alone added to hot water and kerosene in making kerosene emulsion stock greatly increases the adhesiveness of the kerosene emulsion. Use one pound of the Resin to each one gallon of kerosene in making the original stock emulsion before diluting.

60. Syrup or Molasses.

Any cheap grade of molasses added to a spray increases its adhesiveness, and is consequently useful upon smooth plants. Syrup, 1 pint; Liquid Spray Mixture, 5 gallons.

61. Glue.

Glue can be used to make a spray liquid stick by dissolving it in hot water and adding it to the liquid.

Glue, 1 pint or one pound; Liquid Spray Mixture, 5 gallons.

62. Flour.

A cheap grade of flour is useful not only as a carrying agent to convey dust spray or insect powders, but when dusted over damp leaves will also help to hold them upon plants.

Flour, 1 part; Diluted Spray Dust, 12 parts, or Flour, 1 pound; Spray Liquid, 5 gallons.

If the flour be boiled with water and made into a regular flour paste, it will be improved as an adherent in a spray mixture.

63. Salt.

Salt is recommended by many persons to increase the adhesiveness of certain washes, such as Lime-sulphur Washes and also Whitewash. Use one pound to three or five gallons of liquid.

(To be concluded in the June issue.)

SPECIMENS RECEIVED DURING APRIL, 1907.

Number.	Specimens.	Date—April, 1907.	Name and Address.
	Insects.		
8790	Insects,	1	G. R. Pritchard, Harrisburg.
8792	Scurfy Scale,	1	W. L. Campbell, Euclid.
8795	(a) Scurfy Scale,	1	J. K. Yoder, Mattawana.
8797	Scurfy Scale,	1	W. R. Spatz, Mt. Carmel.
8798	(a) Scurfy Scale,	1	I. M. Oglevee, Hanlin Sta.
8800	Scurfy Scale,	1	I. Rhoads, Catawissa.
8802	(a) Scurfy Scale,	1	J. H. Hathrill, Moscow.
8803	Twice-stabbed Lady Beetle (C. bivulnerus).	1	J. F. Heckert, Northumberland.
8804	Moth eggs,	1	Miss. E. Warner, Pineville.
8807	Promethea Cocoon,	2	Miss. E. D. Morton, Ingram.
8808	(a) San José Scale, (b) Rose Scale (A. rosæ),	2	D. Morehart, Montgomery.
8809	San José Scale,	2	E. E. Schaffer, Brick Church.
8811	Wheel Bug eggs (P. cristatus),	2	T. H. Parker, Norristown.
8812	(a) Oyster-shell Scale,	2	O. Lochmann, Newtown Square.
8813	Oleander Scale (A. hederæ),	2	Mrs C. Dunkle, Temple.
8818	(a) Scurfy Scale,	3	S. Swartz, Spring Forge.
8819	Tessellata Scale (Lecaniodiaspis tesselata).	3	Mary M. Haines, Cheltenham.
8823	San José Scale,	3	W. C. Barger, Hollidaysburg.
8825	San José Scale,	3	Lemasters Warehouse Co., Lemasters.
8826	(a) Scurfy Scale, (b) San José Scale.	3	D. Metzger, Linglestown.
8831	(a) Oyster-shell Scale, (b) Scurfy Scale,	4	B. S. Duncan, Ore Hill.
8832	Oyster-shell Scale,	4	J. M. Hammond, Northfort.
8833	(a) San José Scale, (b) Scurfy Scale,	4	A. Berry, Roxborough.
8834	Oyster-shell Scale,	4	D. Schlosser, Erie.
8837	Oyster-shell Scale,	5	A. J. Eberly, Raughts.
8838	Canker Worm Moth and Eggs,	5	D. W. Fisher, New Wilmington.
8844	(a) San José Scale, (b) Scurfy Scale,	8	S. Swartz, Spring Forge.
8845	Oyster-shell Scale,	8	W. A. Brown & Sons, Osceola Mills.
8847	Polyphemus Cocoon,	8	S. E. B. Lingamfelten, Greencastle.
8848	San José Scale,	8	W. Forcey, Beech Creek.
8849	(a) San José Scale, (b) Scurfy Scale,		Dr. J. R. Rodgers, Carlisle.
8851	Cecropia Cocoon,	9	T. A. Gartley, New Castle.
8855	Mealy Bugs,	9	O. S. Gottshalk, Iron Bridge.
8856	Eyed Elater,	9	C. LeFevre, Lisburn.
8859	(a) San José Scale, (b) Pistol-case Bearers, (c) Tree-cricket Egg Punctures,	9	Prof. Beisline, Mechanicsburg.
8860	San José Scale,	9	Rev. J. O. Clippinger, Mechanicsburg.
8861	Tree-cricket Egg Punctures,	10	C. H. Rich, Woolrich.
8865	(a) Cecropia Cocoons, (b) Promethea Cocoons, (c) Polyphemus Cocoons,	11	C. H. Knipe, Marietta.
8866	Oyster-shell Scale,	11	L. Martin, Clarence Centre, N. Y.
8867	Canker Worm Eggs,	11	H. J. Collins, Volant.
8868	(a) Oyster-shell Scale, (b) Scurfy Scale,	11	W. W. Clark, Conneaut Lake.
8874	(a) Oyster-shell Scale, (b) San José Scale,		
8875	Oyster-shell Scale,	12	A. D. Hamilton, Penbrook.
8878	Cecropia Cocoons,	12	D. H. Miller, East Orange, N. J.
8879	Aphis Eggs,	12	J. E. Patterson, Wilkes-Barre.
8880	Scolytid Beetles,	12	G. W. Michaels, Baldmont.
8881	(a) San José Scale, (b) Scurfy Scale,	13	Dr. I. H. Mayer, Willow Street.
8882	Insects,	13	B. F. Merrell, Wilkes-Barre.
8884	Promethea Cocoons,	13	W. C. Dickson, Wayne.
8885	Bagworm Cocoons,	15	F. S. Andrews, Wellsboro.
8887	(a) Scurfy Scale,	15	W. D. Dixon, St. Thomas.
8888	(a) San José Scale, (b) Variegated Cutworms Eggs (P. m. saucia).	15	John Bowman, Pottsville.
8889	(a) Tarrapin Scale, (b) San José Scale,	15	Mrs. J. W. Atkinson, Buckingham.
8892	San José Scale,	15	J. Hemminger, Carlisle.
8895	(a) Tussock Moth Eggs, (b) Cecropia Cocoon,	16	D. Light, Cochranville.
8896	Oyster-shell Scale,	16	Mrs. E. Morton, Ingram.
		16	C. M. Warner, Lehighton.

Number.	Specimens.	Date—April, 1907.	Name and Address.
8902	Oyster-shell Scale,	17	W. Hughes, Kylertown.
8903	Katydid Eggs,	18	F. M. Bream, Gettysburg.
8905	(a) Scurfy Scale,	18	H. Kerstetter, Liverpool.
8906	Katydid Eggs,	18	R. M. Adams, Lancaster.
8908	(a) Scurfy Scale,	18	E. W. Rarig, Catawissa.
8909	(a) Scurfy Scale,	18	J. Schatzle, Aquashicola.
8910	(c) Bird Louse from Horned Grebe,	19	C. L. Woodcock, Raymond.
8910	(d) Bird Louse from Reb-breasted Merganser.		
8913	Scurfy Scale,	19	A. J. Beltz, Allentown.
8914	(a) San José Scale,	19	R. C. Banes, Wallingford.
8915	San José Scale,	19	A. C. Strode, Reedsville.
8917	Work of Scolytid Eggs,	20	F. C. Haines, Germantown.
8919	Oyster-shell Scale,	22	H. J. Collins, Volant.
8920	Scurfy Scale,	22	A. H. Rothermel, Reading.
8921	Cecropia Cocoon,	22	L. J. Walker, Covington.
8922	(a) Plant Lice,	22	Rakestraw & Pyle, Kennet Square.
8925	(a) San José Scale,	22	E. M. Mixer, Wate-ford.
	(b) Scurfy Scale,		
8926	(b) Darkling Beetle (H. aereus),	22	J. M. Schenck, Enid.
8927	Cecropia Cocoon,	22	D. M. Stone, Stull.
8928	(a) San José Scale,	22	W. W. Harper, Chestnut Hill.
8929	Katydid Eggs,	22	H. T. Huyett, Shillington.
8930	Scurfy Scale,	22	H. B. Leighty, Newry.
8936	Oyster-shell Scale,	23	J. F. Brubaker, Lebanon.
8937	(a) Oyster-shell Scale,	23	M. Snyder, Fisher's Ferry.
	(b) Scurfy Scale,		
8938	(a) San José Scale,	23	W. M. Emerick, Shamokin.
	(b) Oyster-shell Scale,		
	(c) Lecanium,		
8939	(a) Scavenger Beetle (C. carolina),	23	N. H. Wilburn, Derry Sta.
	(b) Cicada larva,		
8940	(a) Scurfy Scale,	23	E. M. Lydick, Indiana.
8941	Ground Beetle Larva,	23	F. L. Witherup, Emlenton.
8942	(a) San José Scale,	24	E. Welles, Wilkes-Barre.
	(b) Scurfy Scale,		
	(c) Cherry Scale (A. ostreaeformis),		
8945	(a) San José Scale,	24	H. A. Melhuish, Picture Rocks.
	(b) Scurfy Scale,		
	(c) Oyster-shell Scale,		
8946	(a) Oyster-shell Scale,	24	L. T. McCabe, Waverly, N. Y.
8949	Cecropia Cocoon,	25	P. W. White, Cogan Sta.
8951	(b) Assassin Bugs,	25	W. C. Dickson, Wayne.
	(c) Roach,		
8961	White Flies,	26	Miss D. M. Ziegler, Carlisle.
8964	Insects,	26	G. R. Pritchard, Harrisburg.
8965	San José Scale,	26	F. Corss, M. D., Kingston.
8968	Cynip Gall (D. nebulosus),	27	Mrs. J. U. Moore, Transfer.
8969	Cynip Gall (B. cuscutaeformis),	27	H. M. Conser, Sunbury.
8970	Plant Lice,	27	W. N. Flanagan, Columbia.
8974	Oyster-shell Scale,	29	T. B. Roth, Greenville.
8977	(b) Polyphemus Cocoon,	29	J. B. Richard, Barto.
8979	Hemiptera Eggs,	29	G. P. Williams, Waterford.
8981	Diptera Larva,	29	L. L. Springer, Edenville.
8982	Oyster-shell Scale,	29	A. H. Clark, Muncy.
8984	(a) Oyster-shell Scale,	29	D. H. Davis, Tunkhannock.
8985	(a) San José Scale,	29	J. P. W. Craighead, Carlisle.
	(b) Katydid Eggs,		
8992	Bagworm Cocoons,	30	J. D. Moyer Souderton.
8993	Scurfy Scale,	30	L. Snyder, East Mauch Chunk.
8995	Scurfy Scale,	30	E. S. Shirk, Lebanon.
8996	(a) Oyster-shell Scale,	30	J. W. Steward, Weatherly.
	(c) Scurfy Scale,		
8997	San José Scale,	30	E. L. Myers, Gardenville.
8998	Oyster-shell Scale,	30	C. D. Weed, Waymart.
8999	Oyster-shell Scale,	30	A. Rhoads, Berlin.
9000	Promethea Cocoons,	30	J. S. Campbell, Cheswick.
9001	Oyster-shell Scale,	30	H. J. Miller, Butler.
9002	Oak Scale (C. obscurus),	30	W. W. Long, Washington.
	Invertebrates Not Insects.		
8795	(b) Mites,	1	J. K. Yoder, Mattawana.
8799	(b) Mites,	1	I. M. Oglevee, Hanlin Sta.
8808	Mites,	1	H. J. Hathrill, Moscow.
8805	Snails (Physa heterostropha),	1	J. Couch, Hickory.
8853	Mites,	9	A. B. Thompson, Mercer.
8878	Centipede,	13	Mr. Franklin, Harrisburg.
8887	(b) Mites,	15	J. Bowman, Pottsville.
8888	(c) Garden Spiders,	15	Mrs. J. W. Atkinson, Buckingham.
8909	(b) Mites,	18	J. Schatzle, Aquashicola.
8914	(b) Mites,	19	R. C. Banes, Wallingford.
8923	(b) Mites,	22	W. W. Harper, Chestnut Hill.

THE MONTHLY BULLETIN OF THE DIVISION OF ZOOLOGY FOR JUNE, 1907.

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OUR MONTHLY CHAT WITH READERS.

A CORRECTION.—Notwithstanding the most careful proof reading, errors are liable to occur in our Bulletins as in other publications, and when these are only mistakes of grammar, punctuation or printing, we do not count them sufficiently important to take time and space to correct them, but when they become errors of scientific facts or statements, it is important that they be corrected. For this reason we call your attention to the omission of one important word in the middle of page 386 of the March Bulletin. The third paragraph reads "Other enemies of the Cabbage Root are known to be small Carabid Beetles or Ground Beetles." The truth is that Carabid Beetles or Ground Beetles are among the most beneficial of insects, because they are predaceous, feeding upon other insects, most of which are pests. In this case the Carabids were found by our field assistant feeding upon the Cabbage Root Worm, and consequently the word "Maggot" or "Worm" should be inserted after the word "Root" in line 23 of page 386. It makes a difference to the cabbage grower that is of considerable importance.

CHANGE OF TITLE.—Readers of the Bulletin may notice the change in the title of the Bulletin and the appearance of the first page. This was done for the purpose of reducing the amount of printing and the various styles of type used on that page, and to give a definite title that could be used by librarians in indexing these publications in the different libraries of the country. Also the general subject of each Bulletin is inserted in the first page in such a way as to give the reader an idea of the contents. The detailed statement of contents will be continued on the second page as in the past. These Bulletins reach libraries in practically all civilized parts of the World, in exchange for publications useful to this office, and librarians have found it important to make use of such systems in their cataloging. As a consequence this Bulletin will hereafter be known as the "Zoological Bulletin of the Division of Zoology." It will be published monthly until further announcements are duly made in its pages. It is, of course, sent free to all persons who request it.

THE ENLARGED ISSUE.—The Economic Zoologist is pleased to be able to report to readers of the Zoological Bulletin of this Division that the last Legislature provided for an enlarged issue of the Bulletin, enough to meet the demands of the people. This bill met with the approval of Governor Stuart, and we are now able to add to the mailing list all the names sent to us to the extent of twenty-

five thousand more. Unfortunately, the March and April issues are already practically exhausted, and they will not be re-printed, although arrangements may be made for a republication of the August-September issue, 1906, which is now known as the Pennsylvania Snake Bulletin. Schools, clubs, societies and other organizations, libraries or individuals desiring future issues of these Bulletins may obtain, free, whatever number they desire by writing to this office for them.

THE NEXT BULLETIN.—The next Zoological Bulletin will be on the subject of the Hemiptera or a Suborder of the Order of Insects known as Hemiptera or True Bugs, the discussion of which was commenced in the Bulletin for June, 1906.

Those who have watched our Bulletins carefully know that our plan has been to discuss all of the various Orders of the Insects found in Pennsylvania, beginning with the lowest and continuing through to the highest. The Bulletins upon Insects are monographic or completing one particular Group at a time. These are issued as numbers of the Monthly Bulletin and several have already been prepared, and more will follow before the various Orders of Insects are discussed in their economic and practical relationships. This explanation is made in order that readers can understand the apparent break in the Bulletins due to the insertion of a discussion of a Group of Insects instead of the regular treatment of formulae and pests.

SPECIMENS WANTED.—To aid in our investigations of insects and enemies, the office of the Economic Zoologist desires to receive specimens of insects of all kinds as well as their enemies. We especially wish specimens of amphibians or salamanders, newts and frogs, as it is our desire to make the October Bulletin upon this subject. We also desire specimens of reptiles, including the serpents, turtles and lizards. Insects should at all times be sent in such manner that they will not be crushed in the mail, and larger specimens may be sent by express, at our expense. We particularly desire that all reptiles and amphibians be killed before sending them, in order that the food which they have eaten will be preserved, and we can make a careful study of their stomach contents. We do not ask for toads, as they have been sufficiently studied to be well known, and there is no question of their great economic value. The name and address of the sender should be on or in each package.

Address all packages and communications to H. A. Surface, Harrisburg, Pa.

PART I. FORMULAE AND METHODS—Concluded.

I. E. PRACTICAL PREVENTIVE MEASURES.

X. Farm Practice.

64. Rotation of Crops, as for Wireworms, Corn Root Worms, Hessian Fly, etc.

65. Selection of Good Stock or Seed.

This is necessary with both plants and animals in order to secure immunity from diseases and pests and obtain the best results.

66. Starting Plants Early and Setting Strong Plants.

By getting ahead of the insects at the start one can often keep ahead of them. This is especially true of such pests as the Striped Cucumber Beetles, Flea Beetles and others.

67. Proper Dates of Farm Operations.

(a) Of Plowing, as in plowing very late in fall and very early in spring for Cutworms, Wireworms and other insects in the soil, and also midsummer plowing to destroy the Hessian Fly in wheat stubble.

(b) Of Planting, as in planting wheat late to avoid the Hessian Fly, planting cabbage early to avoid Cabbage Root Worms and planting it at such time as will come between the broods of this pest.

(c) Of cultivating, as in cultivating late in fall and early in spring to avoid Cutworms and Wireworms, and also cultivating in August and September to destroy the Apple Maggot and Plum Curculio in the soil.

(d) Of Harvesting, as in gathering cabbage before it is attacked by Black Rot, picking berries before they are injured by fruit-eating insects and birds and mowing cultivated hay before the Clover-head Midge is sufficiently mature to pass to the ground and live.

68. Early Destruction of all Unused Parts of Plants.

This is important whether insects or plant diseases be present upon the plants or not. As soon as peas are picked the vine should be burned to destroy the Pea Lice, when cabbage is cut the stocks should be burned, when potatoes are lifted from the ground the vines should be burned, as soon as strawberries are picked the leaves should be mowed as closely to the ground as possible, dried in the hot sun, raked together and burned. This will prevent leaf blight and other pests. When blackberries and raspberries are gathered, the canes should be cut at once and burned. When wheat is har-

vested in which Hessian Fly was present the best means of preventing its recurrence the coming fall is to plow down or burn over the stubble at once. This will be an important principle to apply to nearly all crops.

69. Immediate Destruction of Fallen, Infested and Decaying Fruits.

Some insects, such as Apple Maggot or Railroad Worms, Curculio of Plum and Peach, Codling Moth and other pests, remain in fallen fruit a short time before passing into the soil to pupate or transform. If these fruits be destroyed as soon as they drop the pests are killed. When infested or decaying fruits are seen on vines and trees or on the ground beneath them, they should be gathered and burned at once, destroying both the insects and the germs of plant diseases. Pasturing orchards with pigs and sheep is one means of accomplishing this destruction of fallen fruits.

70. Clean Farming.

(a) Clearing away Rubbish, as in burning brush, leaves and grass, etc., to destroy the hibernating places of insects, and especially to prevent mice from finding concealed quarters in orchards, which they gnaw if left covered with leaves and grass.

(b) Clearing away Weeds, as in destroying mustard and preventing the occurrence of lice and root worms injurious to grapes and other cultivated plants of the mustard family. Many kinds of weeds are liable to sustain insects that may become injurious to various cultivated plants, and even plant diseases are at times transferred from weeds to cultivated plants of choice varieties. Prevent this by this important method of clean farming.

(c) Clearing away Volunteer Plants, etc., as in destroying the volunteer or self-planted wheat stocks of late summer to prevent the Hessian Fly from developing on them and becoming a menace to cultivated crops planted later. The destruction of wild or volunteer fruit trees by the tens of thousands in this State would prove of immense value to the careful orchardists who spray continuously for the Codling Moth and other orchard pests, such as the Tent-caterpillar and scale insects, and as regularly have their orchards reinfested by the pests that are continually propagated upon the wild or seedling fruit trees in their regions.

(d) Pruning, Clearing away Extra Branches and Dead and Dying Trees, etc.

The cause of the death of a branch often remains in the branch and can be removed by cutting it away or pruning the living wood. One should always cut some inches below the dead branch to be sure to remove the cause of the trouble. Pear Blight, Bark Beetles and other pests and diseases are to be removed by this as the best possible method.

71. Proper and Frequent Cultivation.

Not only are plants greatly strengthened by this important means of farm practice, but insect pests and plant diseases are greatly discouraged thereby.

72. Draining Wet Land, as for Cutworms and Wireworms, and especially Mole Crickets on damp soil.

73. Irrigating Dry Land or Occasionally Flooding.

Wherever it is possible to flood land for a few weeks during the fall or winter, the pests in that soil will be killed. Recent Bulletins have shown that the best method of treating some pests, such as various kinds of cranberry insects, is to flood the cranberry bogs for even a short time (24 hours) occasionally while the pests are on the growing plants.

74. Strengthening Trees by Pruning, Thinning Fruit, Fertilizing, etc.

Every means of farm practice that will strengthen trees will aid them in withstanding the evil effects of pests. The importance of thinning and pruning have been discussed in our previous Bulletins. (See Vol. II, page 81.)

75. Use of Quickly Acting Fertilizer for Infested Plants.

It is recommended to strengthen certain plants such as wheat by sowing over them when infested some quickly acting fertilizer, such as nitrate of soda, two hundred to three hundred pounds per acre. This acts as a stimulant during the time when insects are most likely to have a killing effect.

76. Killing Pests While Few in Number.

Occasional outbreaks of insects in great numbers is often due to the neglect of persons while they were but few. This is especially true of the Stinking Squash Bug, which may not be perceptibly injurious while few in numbers, and consequently might be neglected, with the result that during the next season they may become very abundant, and it would then be almost impossible to treat them effectively.

77. Planting Trap Crops to Catch and Destroy Pests.

A trap crop may be early planting of seeds of plants of some kind to be protected, as in planting early squash to become well started and receive the eggs of the Squash Borers and protect the latter and more desired crop, or as in planting a strip of early wheat at the side of the field, which is to be sown later and thus trapping the Hessian Fly, which will lay its eggs in the early strip. By destroying the trap

crops when the pests have become well started in them, the insects are exterminated or suppressed. Another kind of trap crop consists of some kind of plant that may be used to take insects from cultivated plants, as in planting mustard seed to produce plants to catch the Cabbage Root Worms and Cabbage Plant Lice, and destroying these plants when infested, or planting a few beans among cucumbers or melon plants to attract Flea Beetles from the vining plants.

XX. Mechanical Devices.

78. Protecting Plants by Nets, Boxes, etc., as in covering vining plants with nets to keep out Cucumber Beetles, Squash Bugs, and other pests.

79. Bands around Trees for Climbing Insects, as in wrapping trees with wool or some sticky substance to prevent Canker Worms and Climbing Cutworms from ascending.

80. Wrapping.

(a) Trees for Borers, Mice, etc., as in wrapping trees with paper or wire netting to prevent borers from reaching them or depositing their eggs, and prevent mice from gnawing them.

(b) Plants for Cutworms, as in wrapping small sheets of paper around garden plants when set in the soil to prevent Cutworms, Wireworms, etc., from attacking them.

81. Painting.

(a) With Paint, as in painting trunks of apple, pear and quince trees with white lead and linseed oil to prevent borers from laying their eggs and entering them.

(b) With Soap, as in painting trunks of trees with soap to kill pests and also prevent borers.

82. Paper Pads or Disks around Plants, as in spreading disks of heavy paper, and putting them flat on the ground around cabbage plants to prevent flies from laying their eggs that hatch into Cabbage Root Worms.

83. Impassable Barriers.

(a) Ditches, Furrows and Holes, such as are made around fields that would be attacked by migrating hosts of insects, such as Army Worms, the young or wingless Grasshoppers and Chinch Bugs.

(b) Line of Tar, as in making an impassable band to serve the same purpose for similar pests.

(c) Tin, Boards, etc., placed around fields or plants to be a protection to prevent certain insects, such as wingless Grasshoppers, from passing them.

XXX. Chemical Preventives or Repellants.

84. (a) Ashes, (b) Soot, (c) Dust, etc.

These substances are used around beds of plants in gardens to keep out such pests as snails and slugs, and may also be dusted over plants to prevent insects from attacking them.

85. (a) Camphor, (b) Moth Balls, (c) Cedar Oil, (d) Heliotrope.

These are substances to place in closed vessels, chests, closets or cases to keep pests from entering. They will not kill Clothes Moths or other pests, but if they be in closed receptacles will generally prevent them.

86. Fish Oil.

The chief virtue of Fish Oil is as a repellant, rather than a means of killing insects. (See Formula 33.)

87. Kerosene.

(a) Kerosene Sand. By adding a quart of Kerosene to about one peck of sand and stirring it well, a mixture is made which will repel insects, and keep them from laying their eggs around the roots of plants, as in placing a handful of this mixture near the roots of cabbage plants or around onions for the root worms of these plants.

88. Tar, as in using a teaspoonful of tar in a quart of warm water to pour over one-half bushel of corn to make it bitter and prevent crows from pulling it, or ground-inhabiting insects from eating it while in the ground. But note that this will only protect the grain and not the young shoots that come from it.

89. Lime, as in dusting this substance over the leaves of plants, such as cucumbers and melons to prevent insects from attacking them. Its value as a repellant will be increased by the addition of a little turpentine.

90. Nitrate of Soda.

This has been recommended to mix in the soil around the roots of plants to strengthen them, at the rate of three hundred pounds per acre. It acts not only as a quick fertilizer for plants but also as a repellant to keep out certain insects.

91. Turpentine.

When added to lime or some other substance that will absorb it and placed around plants it has some effect in repelling certain kinds of insects.

XXXX. Vital Means.

92. Strengthening Crops by Fertilizing, Cultivating, Pruning, Thinning, Watering, Draining, etc.

Every means by which plants can be strengthened is a vital means in enabling the plant to withstand the attacks of enemies, whether they be insects, plant diseases, or other pests.

93. Destroying Allies of Injurious Insects, as in using various means to destroy ants in corn fields that protect the root lice on corn plants.

94. Preserving Beneficial Insects, as in watching for lady beetles, or ladybirds, and parasites on our various insects and permitting them to remain undisturbed.

95. Preserving Insectivorous Reptiles, Birds and Mammals, such as Striped Snakes or Garter Snakes, Black Snakes, Green Grass Snakes, nearly all Birds and also Skunks, Moles, etc.

The importance of preserving beneficial insects and insectivorous animals is too great to be passed without a few words of emphasis. The insect pests in our country are increasing rapidly and there is not a year that does not see new species introduced. The introduction of obnoxious pests is far greater than the introduction of those that are beneficial, for as the chief allies of the former in holding these pests in suppression are their natural parasites and insectivorous birds and other animals, we can see that by far the best thing to do is to learn how to recognize these important allies in order to secure their continued co-operation in destroying our foes. The natural enemies of pests are more powerful, as a constant and effectual check upon their increase, than any spraying operations that can be performed. To learn to know these natural enemies requires care, time and close observation, but the effort is fully justified.

Part II. The List of Cultivated Plants with Prominent Pests of Each and Methods of Treating the Latter follows:

CALENDAR FOR 1907.

PART II. PLANTS, PESTS AND TREATMENT.

Plant.	Insects or Disease.	Treatment.
Apple, ...	Aphis or Plant Lice, ...	(1) About the time the buds burst use Kerosene Emulsion, repeat this at any time the Aphids or Plant Lice are present before the leaves become curled to cover them. (2) Spray with Whale Oil Soap Solution in place of Kerosene emulsion. Repeat as needed. (3) After the leaves become large and twisted so that the Plant Lice are protected make a strong solution of soap and water and by holding this in a pan and bending the infested twigs so that the leaves are dipped into the solution they will be washed and the Lice will be killed by coming into contact with it.
	Codling Moth, ...	Spray with Paris Green or Arsenate of Lead as soon as the blossoms have fallen and repeat ten days later. Scrape the loose bark from the trunks. Fruit fallen early should be fed to pigs. Protect the little Woodpeckers, wrongly called "Sapsuckers."
	Bud Moth, ...	Spray with Paris Green or Arsenate of Lead as soon as the green leaves show in the buds. Repeat just before the blossoms open and again after blossoms fall.
	Bitter Rot, ...	Spray with Bordeaux Mixture before the blossoms open, and again after the blossoms fall. Repeat every ten days until the fruit begins to ripen.
	Canker Worm, ...	Spray with Paris Green or Arsenate of Lead as soon as the Caterpillars appear. Repeat in a day or two if all are not killed by the first application. Also, cultivate thoroughly in June and July to break up the cells in which they pass the winter. Destroy eggs in April. Put bands of loose cotton, wool or sticky substance around the trees in February and March.
	Borers, ...	Drive sulfur matches into their holes Dig them out in the fall, or inject carbon Bisulfid and plug the holes with clay, or wrap trunk of tree from below the surface of the ground to a foot above, during June, and allow to remain this way until December. Whitewash, with Paris Green added to the regular mixture, the trunks of trees during June. Paint trunks in May or early part of June with pure White Lead and Linseed Oil.
	Case Bearer, ...	Same treatment as for Bud Moth.
	Leaf Rust, ...	Destroy all red cedar trees near the orchard, as one of the necessary steps in the life history of the Apple Rust is in the form of Cedar Apples or the knotty balls on red cedar trees.
	Oyster-shell Scale and Scurfy Scale.	Spray while trees are dormant with the Lime-sulfur Wash or spray about May 25th with dilute Whale Oil Soap or other mild contact insecticides.
	San José Scale, ...	(a) When trees are dormant or without leaf: (1) Cut back the trees in proprtion to their injury, and paint every part of the bark with a Lime-Sulphur Wash or with a thick solution of Soap. Apply it by hand, using a paint brush and go over the trees at least twice, to be sure they are well coated. (2) Spray with the Lime-Sulphur Wash, or with Whale Oil Soap, two pounds in one gallon of water. (3) Repeat these opera-

PART II. PLANTS, PESTS AND TREATMENT—Continued.

Plant.	Insects or Disease.	Treatment.
		tions in the spring as late as possible before the buds burst, even through they may have been performed in the fall when the first application should have been given. (See previous Bulletins of this Department in order to learn which material is best to use according to the size of the orchard, the trees, and other local conditions.) (b) When trees are in foliage: Spray at least four times at intervals of five or six days each with Kerosene Emulsion, eight or ten per cent. or Whale Oil Soap, one pound in six or seven gallons of water, or other contact insecticides. When a few trees are badly infested it will be much better to cut them out and burn them in order to save others, or paint them at any time of year by hand with a brush using thick Whale Oil Soap, or other soap solution or Lime-sulphur Wash. This can safely be done in the summer if the insecticide is kept off the leaves. Buy no trees excepting from reliable nurseries and insist upon their being accompanied by tags showing that they have been both inspected and fumigated.
	Scab, ...	Spray with Copper Sulfate before the buds burst and with Bordeaux Mixture just before the blossoms open and again after the petals fall, and at intervals of ten days until the fruit begins to ripen.
Apricot, ...	See "Peach,"	Treatment is the same as on Peach trees.
Asparagus, ...	Beetles, ...	(1) Cut the entire patch to destroy food supply. (2) Give the chickens the run of the patch. (3) Dust with Air-slaked Lime or with Flour and Pyrethrum, or spray with Paris Green after cutting has stopped.
	Rust, ...	(1) Cut all plants low and frequently. (2) Spray with Bordeaux Mixture after the cutting has stopped. (3) Burn the rusted plants in fall before they are entirely dead.
Beans, ...	Anthracnose (or Red Spot),	(1) Spray with Bordeaux Mixture when the first true leaves have formed. (2) Repeat with Bordeaux Mixture often enough to keep the mixture on the plants until shortly before the pods are to be eaten. (3) Soak the seeds for one hour in Cupram or Formalin before planting them.
	Mildew, ...	(1) Spray with Potassium Sulphide before it appears. (2) Burn all parts of the plant as soon as possible after the best part of the crop is gathered.
	Weevil, ...	Fumigate the seed as soon as gathered and again before planting with Carbon Bisulphide or Hydrocyanic Acid Gas.
Beet, ...	Leaf Spot, ...	Use the Bordeaux Mixture three or four times when the beets are first large enough, and repeat this as often as necessary to keep the mixture on the leaves. Burn leaves as soon as gathered.
	Leaf Miners, ...	Same treatment as Leaf Spot, with Paris Green added to the mixture. Cultivate thoroughly the last of June.
	Rust, ...	Same treatment as for "Leaf Spot."
Cabbage and Cauliflower.	Plant Lice, ...	(1) Spray with Kerosene Emulsion whenever the insects are present and use Resin or Soap to make this adhere. Repeat whenever the lice are seen. (2) After the plants become headed use Tobacco or Hot Water. (3) Spray with Soap Solutions.
	Caterpillars, ...	(1) Destroy by hand-picking. (2) Spray with Paris Green and an adherent until the plants commence to head or the cauliflower to form.
	Club Root, ...	(1) Burn infected plants as soon as they are found to have the disease. (2) Practice rotation of crops to put the plants on soil that do not carry these germs. (3) Treat the seed before plant-

PART II. PLANTS, PESTS AND TREATMENT—Continued.

Plant.	Insects or Disease.	Treatment.
		ing with Corrosive Sublimate or Formalin. (4) Use lime 75 bushels per acre in rows where cabbage is to be planted. (5) Inject a half-teaspoonful of Carbon Bisulphide into the soil around the roots of each diseased plant.
	Cabbage Worm, ...	(1) Spray with Paris Green or Arsenate of Lead, or Kerosene Emulsion, or Kerosene Mixture. (2) Repeat No. 1 as often as enough Cabbage Worms are seen to justify the treatment. (3) After the heads of the plants are half-formed use Hellebore, or Hot Water, or Kerosene Emulsion. The poisons may be safe but it is not best to recommend them. (4) Dust the plants with fresh Lime and Pyrethrum while the dew is on.
	Harlequin Bug, ...	(1) Plant an early trap crop or mustard to catch the bugs, then spray them with pure kerosene to kill them. (2) Pick them by hand.
	Root Maggot, ...	(1) Rotate crops and plant as far as possible from where this pest was present the previous year. (2) Sprinkle each plant with a solution of Whale Oil Soap, using one pound to eight gallons, and apply enough of the solution to permit it running down the stalk and among the roots of the plants. Do this early before the larvæ have worked down to much depth. (3) Lean the plants to one side and apply one-half teaspoonful of salt pushed down at the side of the plant to the roots. (4) Inject a half-teaspoonful of Carbon Bisulphide among the infested roots and close the hole.
Carnations, ...	Authracnose (or Rust Spot),	Use Bordeaux Mixture or Cupram, or Soda Bordeaux at the first signs of rust. Repeat this every two weeks until the flowers appear, then use Ammoniacal Solution of Copper Sulphate to avoid the blue stain.
	Red Spider, ...	Knock these off house plants by using forceful jets of water, as from a hose, or use Kerosene Emulsion or Whale Oil Soap or Potassium Sulphide. Dust with sulphur and lime.
	Mildew, ...	See Bean-Mildew.
Celery, ...	Blight or Rust, ...	Cupram, repeat once a week. Arrange a shade over plants.
	Caterpillars, ...	Use Paris Green, while the plants are small, if the caterpillars be very numerous, or pick them off by hand, at any time, especially when the plants become larger.
	Soft Rot, ...	(1) Keep the plants dry. (2) Keep the plants entirely submerged under pure water.
Cherry, ...	Aphis, ...	See "Apple"—Aphis.
	Black Knot, ...	See under "Plum."
	Curculio and Wooly Aphis,	See under "Plum."
	Rot, ...	(1) Bordeaux Mixture when the buds burst or before the blossoms open. Repeat when the fruit has set. (2) Use Cupram when the fruit is full-grown and again just as it commences to show the first signs of ripening.
	Leaf Blight, ...	Same treatment as for "Rot."
	Slug, ...	(1) Spray with Paris Green or Arsenate of Lead, or Hellebore, or dust with air-slaked lime. The Dust Spray with Paris Green is very good. Repeat whenever the slugs are seen.
Chrysanthemum, ...	Leaf Spot, ...	Spray with Bordeaux Mixture or Cupram every two weeks or as often as necessary to keep the material on the plants. Repeat this and use Cupram after the blossoms commence to appear.
	Rust, ...	Spray frequently with Potassium Sulphide.
Corn, ...	Cut Worms, ...	(1) Trap by poison baits at any time they are present. (2) Rotate crops in such a manner as to avoid corn upon grass sod especially sod of long stand-

PART II. PLANTS, PESTS AND TREATMENT—Continued.

Plant.	Insects or Disease.	Treatment.
		ing. (3) Where it is necessary to plant corn on sod plow the ground in fall and cultivate the ground frequently both as early as possible and as late as possible in fall. Put poison baits in the rows where the corn is to be planted before it is planted or before it is up.
	Boll Worm or Corn Worm,	Pick the pests by hand. Plow late in fall to destroy them while in the ground.
	Smut, ...	Cut out and burn all smut bolls of diseased plants as soon as they are discovered and never permit them to remain in the ground or in manure piles over the winter. Rotate crops where manure is badly covered so that it is not followed soon by corn.
	Corn Root Worm, ...	Rotate crops to avoid frequent planting of the corn in the same ground as this is the best means of overcoming this species of corn pest.
	Lice and Ants on Roots, ..	(1) Rotate crops. (2) Fall plowing. (3) Late cultivation and early spring cultivation to kill all weeds, stir up the soil in which the plant lice live. (4) Frequent cultivation of infested corn field.
	Web Worms, ...	There is no remedy when once planted. Prevent by fall plowing, late planting and thorough cultivation.
	Wire Worms, ...	(1) Rotate crops so that corn does not follow grass. (2) Plow late in the fall and cultivate early and well. (3) Sow 1,000 pounds Kainit to the acre. (4) Make poison baits.
Cucumber, Melon, Squash.	Downy Mildew, ...	Bordeaux Mixture on plants enough to keep them covered. (2) Burn the vines as soon as possible after the crop is gathered.
	Blight, ...	Same treatment as for "Mildew."
	Borer, ...	(1) Use a very dilute mixture of Paris Green and Flour, applying it as a dust over vines. (2) Bury the vines at intervals to permit them to take root at several places. (3) Cut out the Borers by lengthwise cuts wherever they occur. (4) Kill the adult moths by hand picking on and beneath the leaves. Collect in the morning and evening and when damp.
	Striped Cucumber Beetle,..	(1) Cover the plants by a net until they are well started. (2) Dust them with air-slaked lime and Paris Green, or with air-slaked lime and turpentine, or use other repellants. (3) Dust with tobacco, and put an abundance of powdered or refuse tobacco about the stems and in the soil to keep them from laying their eggs in the soil where the young feed upon the roots.
	Squash Bug, ...	(1) Pick them by hand and kill them. (2) Spray with Kerosene Emulsion or Whale Oil Soap when they are on the ground. (3) Place board traps for them. (4) Spray with Kerosene or another very strong contact insecticide in the fall as soon as the plants are no longer valuable and while these pests are yet present. (5) Burn vines as early as possible.
Currant, ...	Currant Worm, ...	Paris Green or Hellebore as a dust or liquid spray when the worms first appear. Repeat whenever necessary.
Gooseberry, ...	Four-lined Leaf Bug, ...	Kerosene Emulsion one part to five parts water.
	Gooseberry Fruit Worm, ..	(1) Let fowls run among the plants to devour the pests and the infested fruit as often as it falls. (2) Pick off the infested fruits and destroy them whenever they are to be found. (3) Rake up and burn the fallen leaves near the bushes in the fall. (4) Spray with an arsenite before the fruit is half-grown.
	The Stem Girdler or Borer,	Cut the infested stems some inches below the girdled place and burn them.
	Leaf Blight, ...	Spray with Cupram. (1) While the fruit is present. (2) After gathering the fruit with Bordeaux Mixture to keep the leaves covered.

PART II. PLANTS, PESTS AND TREATMENT—Continued.

Plant.	Insects or Diseases.	Treatment.
Egg Plant, ...	Leaf Spot, ...	Bordeaux Mixture as soon as the leaves are out, and repeat this as often as is necessary to keep the leaves covered. Use Cupram when the fruit is nearly ripe enough to gather. Gather and burn the fallen leaves.
Elm, ...	Elm-leaf Beetle, ...	Spray with Arsenate of Lead, or Arsenite of Lime when the leaves first appear and repeat this as often as any pests are to be found attacking them.
	Tussock Moth, ...	(1) Gather and destroy the egg masses on the trunks and larger branches before they hatch in spring. (2) Spray with arsenites when the caterpillars feed. (3) Destroy the egg masses of the second brood in midsummer.
Grape, ...	Anthracnose: or Bird's Eye Rot.	(1) Wash with Iron Sulphate and Sulphuric Acid, or Copper Sulphate one pound in ten gallons before the buds open, and repeat this three or four days later, but do not apply this strength after the leaves start. (2) Spray occasionally with regular Bordeaux Mixture.
	Black Rot, ...	(1) Bordeaux Mixture when the buds are bursting. Repeat every two weeks until fruit is half grown. (2) Then use Copper Carbonate and Ammonia, repeating every week or two if any evidence of rot appears. Pick off and burn all rotting grapes just as soon as they are seen.
	Downy Mildew, ...	(1) Spray with Bordeaux Mixture as soon as the leaves have expanded. Repeat in about ten days or just before the flowers open. (2) Spray with Potassium Sulphide at any time there is evidence of the mildew appearing.
	Grape-vine Leaf Hopper, ..	(1) Dust the vines with insect powder or tobacco dust about the first of July. Repeat whenever the pests are present. (2) Instead of dust spray with dilute Kerosene Mixture, not over five per cent., or dilute Kerosene Emulsion, forcing the insects to fly to the ground and then immediately spray them on the ground with a stronger mixture or emulsion and kill them there where the leaves of the grape will not be injured by the stronger spray.
	Powdery Mildew, ...	(Same treatment as for "Downy Mildew)."
	Ripe Rot, ...	(Same treatment as for "Black Rot," but use the Cupram until fruit is ready to gather, or until there is no danger of rot.)
	Root Worm, ...	(1) As soon as the adult beetles appear on the leaves give the same treatment as for the Grape Vine Flea Beetle. (2) Inject Carbon Bisulphide into the soil around the roots.
	Rose Bug, ...	(1) Pick the beetles by hand as soon as they appear, or jar them from the vines on sheets or bug catcher, or jar them or shake them from the leaves and spray them with Kerosene, either mixed or pure, while they are on the ground where the leaves will not be injured by the spray. (2) Cover the forming bunches of grapes with paper bags.
Hollyhock, ...	Rust, ...	Bordeaux Mixture as soon as the leaves open. Repeat this at intervals of ten days until there is no danger of rust appearing.
House Plants, ...	Aphids or Lice, ...	(1) Spray or wash with soap solution whenever they are seen, or (2) Hold the infested plants in steam a few inches from the mouth of a tea-kettle for a few seconds, or use hot water.
	Mealy Bugs, ...	Same treatment as for "Plant Lice or Aphids," or touch with a small brush dipped in pure Kerosene.
	Nematodes or "Root Worms."	(1) For potting plants use soil that has been from sod one year or more. Heat the earth for three hours before using it either in an oven or with forty to

Plant.	Insects or Diseases.	Treatment.
		sixty pounds of steam. (2) Inject Carbon Bisulphide into infested soil. (3) Remove the soil containing the little white worms on the roots of the plants, wash the roots in warm water, and repot at once with clean soil.
	Scale Insects, ...	(1) Treat frequently as for "Aphids or Plant Lice." At the time the young scale insects appear in their soft and unprotected state, they are easily killed by those methods. (2) Use remedies for scale insects mentioned elsewhere in this Bulletin. (See under "Apple.")
Household Pests, ...	Ants, ...	(1) Trace them to the nest and destroy by pouring in Kerosene, Benzine, Gasolene, or Carbon Bisulphide. (2) Moisten sponges with sweetened water and drop these into boiling water whenever the ants cover them. (3) Many substances are recommended to place on shelves to drive away ants. Among these are red pepper, powdered borax, walnut leaves, pennyroyal, cedar oil, oil of cloves, etc., but nothing is as good as destroying the nest.
	Bedbugs, ...	(1) Fumigate the infested room with Hydrocyanic Acid Gas, or Carbon Bisulphide. Keep it closed at least one-half day, then ventilate it well and there will be no danger. Remember the very deadly effect of these gases when inhaled even in small quantity. This is about the only way to clean up a badly infested house. (2) Dissolve Corrosive Sublimate in Alcohol.
	Carpet Beetles, ...	For pests in carpets: (1) Use a damp towel and hot flatiron. (2) Spray with Corrosive Sublimate and Alcohol, especially under furniture and around the edges of the carpet both beneath and above. (3) Discard the use of carpets and use rugs instead, beating them frequently in the sunshine. (4) Fumigate the infested room as for bedbugs. (Note fumigation by either Carbon Bisulphide, or Hydrocyanic Acid Gas when properly done with the building tightly closed will kill absolutely all kinds of insects and animals, such as rats and mice that are in the building. We have done this work and have proven it effective for ants, bedbugs, carpet insects, clothes moths, fleas, flies, and rats and mice. Any pests in the house will be killed by one and the same fumigation.)
	Clothes Moths, ...	(1) Put woolen clothing and furs in tight paper sacks in the spring before the moth has laid her eggs in them and tie them tightly so she can not enter. The desired results are also obtained by putting such articles into boxes of any kind that are tight, and seal them with strips of paper. (2) Use cedar boxes or chests for storing, or use an abundance of moth balls, cedar oil, lavender, or some other repellent. Remember that these will not kill the insect after it has once entered the clothing, or if it be infested when packed away, but will only keep the moth from laying her eggs where they are used. (3) Fumigate infested clothing in tight vessels, such as wash boilers, barrels or hogsheads. (4) Where clothes moths infest articles that are not injured by boiling, they can be killed by putting them into boiling water for some minutes. (5) Thoroughly brush infested clothing in the open air and hang it in the sunshine for a day. (6) Fumigate the entire house, room, or closet in which the pests are found.

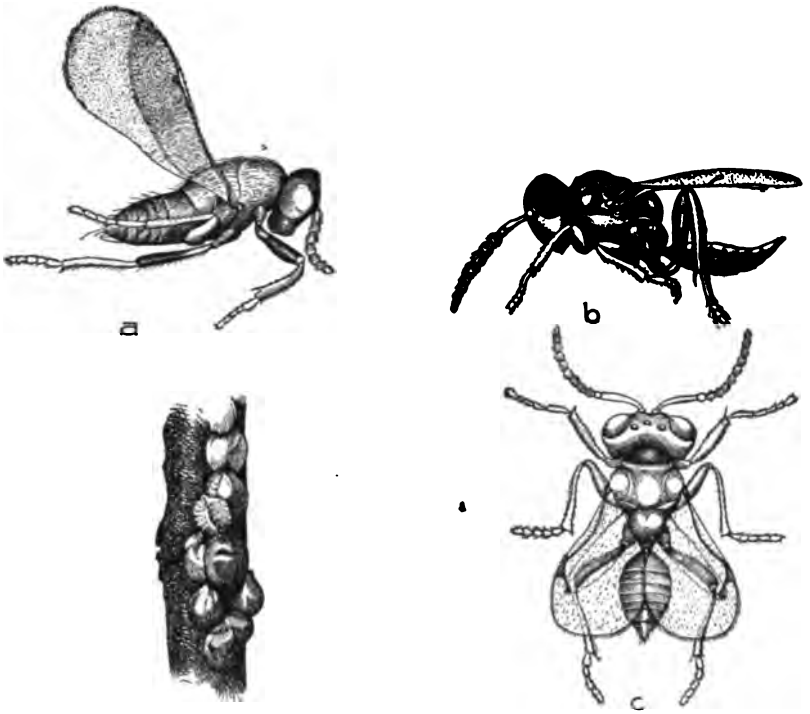
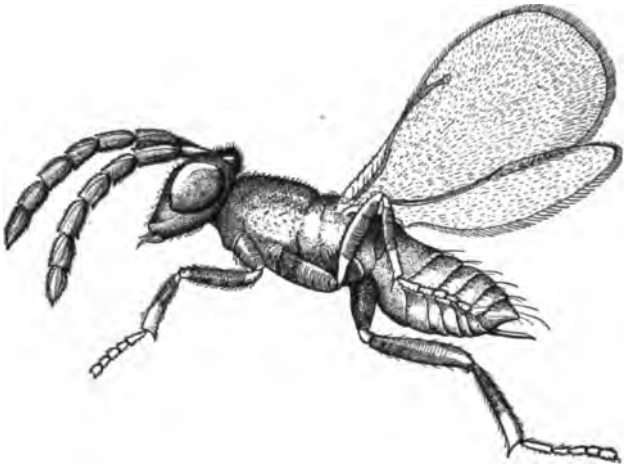


PLATE IV.—Lecanium sp. on Mulberry, slightly enlarged. Fig. a, *Coccophagus immaculatus* Howard, enlarged 30 diameters; b and c, *Pachyneuron micans* Howard, enlarged 30 diameters, Chalcid parasites bred from Lecanium. Drawn in the office of the Economic Zoologist, by W. R. Walton. Specimens sent by Mr. F. G. Stokes, of Philadelphia.

A



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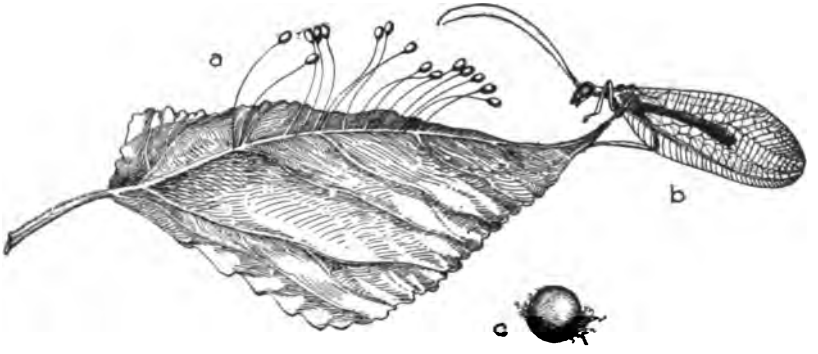

PLATE V.—Fig. A, (*Physcus varicornis* Howard) Chalcid Parasite of Scurfy Scale on Pine, enlarged 65 diameters. Drawn in the office of the Economic Zoologist, by W. R. Walton. Fig. B, Lace-wing (*Chrysopa oculata*); (a) eggs on egg-stalks; (b) adult; (c) cocoon; enlarged 2 diameters. Drawn in the office of the Economic Zoologist, by W. R. Walton. Specimens sent by the Zoological Society of Philadelphia.

PART II. PLANTS, PESTS AND TREATMENT—Continued.

Plant.	Insects or Diseases.	Treatment.
	Fleas, ...	(1) Place rugs or carpets for the dogs and cats to sleep on, and shake or beat these rugs on the grass away from the house every few days. (2) Clean up the sleeping places of dogs and cats as here is where the eggs of most fleas are laid and the young hatch. (3) Scrub infested pets with tar soap, or better, water with three per cent. creolin. (4) Clean the cracks of floors from dust, and fill them with paint, putty or some other substance that will keep the young fleas from living in the dust in such places. (5) Put sticky fly paper on the floor beneath tables and chairs to trap the adult fleas as they jump around. (6) Tie sticky fly papers around boot tops with the sticky side out and walk slowly through the rooms and halls that are infested. Fleas jump toward such moving objects. (7) Dust carpets thoroughly with Hellebore or Pyrethrum, close the room for an hour or two, then sweep the floor well and burn the sweepings. (8) Take up and beat carpet, and scrub floors with water containing three to five per cent. Creolin or Carbolic Acid.
	Flies, ...	(1) Thoroughly and frequently clean stables and all places containing material in which flies breed and the young live. (2) Properly screen all windows and doors. (3) Use sticky fly paper and poisoned fly paper in those parts of the room that are most lighted, especially windows. (4) Dust the infested room well with insect powder and within an hour sweep the room and burn the dust. (5) Fumigate the infested rooms or the buildings, as mentioned above for other household pests.
	Mosquitoes, ...	(1) Watch carefully for their breeding places, and drain all pools in which the young wrigglers live; fill post holes and hollow stumps containing water, empty all old cans, barrels and other vessels that contain water to support the larvæ or wrigglers of mosquitoes, and especially watch rain-water barrels. (2) Put common Kerosene oil or lamp oil on ponds, etc., in proportion of one teaspoonful to a square yard of water. Use this especially on water in cisterns and rain-water barrels and on ponds and ditches that can not be drained. (3) Introduce minnows into ponds, ditches rain-water barrels and cisterns where the young wrigglers live. Of course, these will not thrive in water covered with oil. (4) Screen windows and doors, and also chimneys and holes for stove pipes. It is not infrequent that they get into a room through windows or ventilating shafts.
	Larder Beetles, ...	For Larder Beetles and their larvæ or "moths" that feed upon dried meats, smoked meats, etc., brush the meat well to get rid of the pests and enclose it in tightly tied paper sacks.
	Roaches, ...	(1) For roaches or cockroaches use Powdered borax, Plaster of Paris and powdered sugar, Hellebore, or poison bait, and keep the room as dry and clean as possible, keeping all paste, flour and crumbs cleaned up so that these pests can not feed upon them. (2) Spray the cracks they infest with Corrosive Sublimate in Alcohol.
Lawn Insects, ...	White Grub, ...	(1) Kill the May Beetles or June Bugs as they fly around lights by using lantern traps and by such other means as may be possible. (2) Inject Carbon Bisulphide into the infested soil. We have correspondents who have done this with perfect success.

PART II. PLANTS, PESTS AND TREATMENT—Continued.

Plant.	Insects or Diseases.	Treatment.
Live stock pests, ...	Cut Worms, ...	Use poison traps and board traps.
	Flies, ...	(1) Keep flies from live stock by spraying every day or two with Fish Oil, 100 parts; Oil of Tar, 50 parts; Crude Carbolic Acid, 1 part. Mix or shake these well together and apply as a spray or mist. (2) Clean up all places where flies breed and keep all cleanings from the stables in the field where it is needed for fertilizer instead of in the barn where it is useless and a menace to health and comfort.
	Lice, ...	Animals infested with Lice should be washed with three per cent. Creolin in water, or rubbed with Kerosene Emulsion, or Carbolic Emulsion, or Carbolic Soap and water applied with a brush.
	Bots, ...	(1) Clip the hairs on the front legs and parts of the horse that can be reached by its teeth, and also under the chin and throat where the bot fly deposits its eggs. (2) After the horse is attacked by the bots entering the stomach use the ordinary remedy for this trouble.
	Bots in Head of Sheep, ...	Smear the sides of troughs where sheep are to be salted with tar in order that the sheep will have tar on their noses and keep the sheep-head bot-fly from laying its eggs in the nostrils.
	For Flies in Stable, ...	Screen stables with large mesh netting one-fourth inch square and keep the building darkened excepting from one side. Flies will pass out through these large meshes, but will not enter the stable through them. This method of affording comfort to horses and cattle is used considerably and successfully in the southern part of Europe.
	Sheep Ticks, ...	(1) Dust insect powder freely into the wool. (2) Or better, dip the sheep shortly after shearing, and especially dip the lambs at this time into either dilute Kerosene Emulsion or two per cent. Creolin. The latter is better. Every person who keeps sheep should dip the lambs at this time of year to kill the pest, as they pass from the sheared sheep to the lambs.
	Scab of Sheep or Cattle, ..	Spray or wash with Carbolic Emulsion and thoroughly wash or spray the interior of buildings, floors, etc., with this material or Crude Carbolic Acid, dilute.
	Lice on Cattle, Hogs and Other Animals.	Spray or wash with a three per cent. Solution of Creolin.
Locust trees, ...	Bag Worms, ...	(1) Pick the large conspicuous bags from the trees by hand when the leaves are off. (2) Spray with arsenites when the eggs hatch in early spring. (3) Repeat arsenical sprays at any time during the summer when they are feeding on the leaves.
	Borers, ...	For borers in locust trees which are the most terrible pests of these valuable trees paint the trunks of the trees each spring with pure White Lead and Linseed Oil until the trees reach fair size.
	Leaf-eaters, ...	Whenever leaf-eating insects of any kind are seen, spray with arsenical poisons.
Maple Trees, ...	Aphis or Plant Louse, ...	(1) Spray whenever they are seen with Kerosene Emulsion, Kerosene Mixture, or Soap Solution. (2) Destroy the leaves that fall at mid-summer, carrying the aphis with them. (3) Spray with strong contact insecticides just as the buds are bursting in the spring.
	Cottony Maple Scale, ...	(1) Spray with Kerosene Emulsion, or Kerosene Mixture, or Carbolic Emulsion, or other contact insecticides early in June. (2) Repeat this whenever such pests are seen.

PART II. PLANTS, PESTS AND TREATMENT—Continued.

Plant.	Insects or Diseases.	Treatment.
	Lecanium or Turtle-shell Soft Scale.	Same treatment as for Cottony Maple Scale whenever the pests are seen alive.
	Tussock Moth, ...	(See treatment for this pest under "Elm.")
Nursery Stock, ...	Fungus Diseases, ...	(1) Spray with Bordeaux Mixture as the buds are bursting. (2) Repeat this as often as is necessary to keep the mixture on the leaves.
	Chewing Insects, ...	(1) Spray with Paris Green or other arsenites whenever such insects are seen. (2) Repeat such spray if all are not killed wihin a day of two.
	Sucking Insects, ...	(a) When the trees are dormant: (1) Kerosene Mixture or Emulsion at least twenty per cent. (2) Whale Oil Soap, one pound in two gallons of water. (3) One of the Lime-Sulphur Washes or Kerosene Lime. (b) When trees are in leaf: (1) Dilute Kerosene Applications or Soap Solutions whenever living insects are seen. (2) For San José Scale and similar pests repeat this once each week for four or five weeks. (3) For Scurfy Scale and Oyster-shell Scale spray with one of these insecticides the latter part of May and again the latter part of July.
Oats, ...	Smut, ...	(1) Put the seed oats into sacks so they can be pushed under water, and immerse them in Formalin or a solution of Corrosive Sublimate, and then spread and dry. (2) Sprinkle the oats well on the floor with Formalin and water. (3) Soak the seed five to ten minutes in water at one hundred and thirty-three degrees F.
	Rust, ...	No good treatment is known for rust. Have the soil in good condition, use an abundance of manure or fertilizer, and sow at a time when the seed will sprout quickly.
Onion, ...	Maggot or Root Worm, ...	(1) Rotate Crops or grow the onions at some distance from the place where they were the previous year. (2) Use the same treatment as for the Cabbage Root Maggot. (3) Pour a quart of Kerosene into a common bucket full of sand, stir it well, and place a handful of this sand around each plant before the fly has laid its eggs.
	Mildew, ...	(1) Burn the tops and other unused parts of plants as early as possible. (2) Rotate crops. (3) Spray early with Potassium Sulphide and repeat when needed.
	Smut, ...	(1) Burn all possible material in the fall. (2) Treat the seed with Formalin or Corrosive Sublimate. (3) Start onions by sowing the seed in soil that is not infested and transplant them to the place where they are to mature. This is the best and most modern method in onion production as it saves the great labor of weeding and thinning.
Osage Orange, ...	Borers, ...	Cut off and burn the old stalks as new ones will be formed soon.
	San José Scale, ...	Same treatment as given for this pest under Apple.
Pea, ...	Pea Louse or Aphis, ...	Brush the vine on the dry hot soil at mid-day, using pine boughs with the needles or pins on them, and follow this at once with the cultivator; or brush into pans made for the purpose containing water and Kerosene and drawn between the rows, or spray with Kerosene Emulsion, or Whale Oil Soap, or any other good contact insecticide. Plant only in rows so this work can be done.
	Caterpillars or Leaf-eating Insects.	Spray with arsenites whenever anything is found eating the leaves.
	Weevil, ...	Give same treatment as for Weevil of Bean.

PART II. PLANTS, PESTS AND TREATMENT—Continued.

Plant.	Insects or Diseases.	Treatment.
Peach and Nectarine, ..	Borer of Peach, ...	(1) Wrap the trunk with some material that the moth will not penetrate to lay her eggs. (2) Make a mound of earth at least a foot high around the trunk of the tree about June 1st, and remove this in September. (3) Keep a quantity of ashes, or lime around the base of each tree close to the trunk. (4) Treat the infested tree by pouring on a solution of Lye, Soda or Potash. (5) Cut out borers already in the trees if you do not wish to use remedy No. 4, but if remedy No. 4 is used it is not necessary to cut out the borers, as they will be killed and remain under the bark. Of these remedies the following are preventive or used to keep the borer from entering the peach tree: 1, 2 and 3. Remedies 4 and 5 are to kill the borer after it has entered.
	Black Peach Aphis, ...	(1) Spray with Kerosene Emulsion or Whale Oil Soap shortly after the buds burst, or whenever the pest is seen and use remedies recommended elsewhere for Aphis. (2) When the pest is in the roots use an abundance of refuse tobacco, or powdered tobacco in the soil on the roots, or fumigate with Carbon Bisulphide.
	Brown Rot, ...	(1) Spray with Copper Sulphate before the buds open. (2) Use Bordeaux mixture before the flowers appear. (3) Repeat No 2 at least once every two weeks, or often enough to keep the Bordeaux Mixture on the leaves and young shoots until after the latter is half-grown. After the fruit is nearly grown spray at least once a week with Cupram to avoid staining the fruit.
	Curculio, ...	See treatment of this pest under "Plum."
	Peach-leaf Curl, ...	(1) Spray with one of the Lime-sulphur Mixtures before the buds burst in the spring; or spray with strong Copper Sulphate at that time. (2) Spray with Bordeaux Mixture enough to keep the mixture on the leaves until they are half-grown.
	Peach Rosette and Yellows,	No good remedy is known. Pull and burn the diseased trees.
	San José Scale, ...	(See discussion under "Apple.")
	Yellows, ...	No remedy is known. Dig out and burn all diseased trees, and also remove and burn their roots.
Pear, ...	Borers, ...	(See discussion of these pests under "Apple.")
	Codling Moth, ...	(See discussion of Codling Moth under "Apple.")
	Fire Blight or Twig Blight,	Cut off and burn all blighted parts, cutting at least a foot below the diseased places. Paint the stumps and sterilize the mass occasionally by dipping into turpentine.
	Leaf Blight, Fruit Spot or Fruit Splitting.	(1) Spray with Cupram, or strong Copper Sulphate while the leaves are unfolding. (2) Use Bordeaux just before the blossoms open. (3) Repeat the spray with Bordeaux after the fruit has set and as frequently as is necessary to keep this material on leaves and fruit.
	Leaf Mite of Pear, ...	(1) Spray in winter with Kerosene Emulsion or Kerosene Mixture (25 per cent.) (2) Spray the trees at any time when dormant with one of the Lime-sulphur Washes, exactly as for San José Scale.
	Pear Midge, ...	(1) Apply one thousand pounds of Kainit to the acre to the ground beneath the trees about the middle of June. (2) Or work an abundance of powdered tobacco into the soil about this time.
	Pear Psylla, ...	(1) Spray the entire tree thoroughly when the leaves are off with either Crude Petroleum, or strong Kerosene Mixture, or Lime-sulphur Wash. (2) Spray with Whale Oil Soap, one pound to one gallon of water in April. (3) Spray with regular contact insecticides as

Plant.	Insects or Diseases.	Treatment.
		for Plant Lice if the young Psylla or Jumping Plant Louse is seen upon the leaves or fruit at any time during spring or summer, and repeat the operation while the pest remain.
	San José Scale, ...	Same treatment as for this pest under "Apple," excepting that upon Pear pure Crude Petroleum can be used whenever the leaves are off, and on Pear and Apple much stronger application of all materials can be made at any and all times than upon Peach or Plum.
	Scab, ...	Same treatment as for "Apple Scab."
	Slug, ...	Same treatment as for "Cherry Slug."
Plum, ...	Black Knot, ...	() Spray with Lime-sulphur Wash or any of the Lime-sulphur Washes when the leaves are off. (2) Cut off the branches that contain knot and burn them, cutting at least six inches below the diseased spot, and dipping the knife blade into turpentine occasionally to sterilize it. Wash the cut part with a good paint. Do not fail to burn the knots that are cut off and let none grow anywhere upon the premises. Induce all neighbors to take the same precaution and watch wild or uncultivated plum and cherry trees to see that the knots do not develop upon them and produce spores to infect other trees.
	Borers, ...	Same treatment as for Borers in "Apple."
	Brown Rot or Ripe Rot, ...	Give same treatment as for Brown Rot of "Peach." Permit no rotten plums or peaches to remain on the trees and dry or become "mummies" to carry the disease spores over winter, and destroy rotten fruit as it falls to the ground.
	Curculio, ...	(1) Spray with Paris Green or Arsenate of Lead just after the buds burst and before the flowers open. (2) Spray again with Arsenate of Lead or Arsenate of Lime soon after the petals fall. (3) Catch the insects by jarring them on cloths or catchers spread for them while it is cool at night or in the morning. (4) Gather and destroy fallen plums every day during the part of the year when the larvæ are in them. (5) Cultivate the plum orchard or whatever ground is infested with Curculio about the middle of July when they are in the pupal state in the soil. (6) In thinning plums, peaches and other fruits select and pick off those that bear marks of the Curculio. (7) Keep poultry in the orchards where these insects are liable to occur.
	Lecanium or Plum Scale, ..	(1) Spray with Lime-sulphur Washes after the leaves fall. (2) Or spray with Kerosene Mixture or Kerosene Emulsion when the leaves are off. (3) Repeat No. 1 or 2 in the spring before the buds burst. (4) Spray with a mild contact insecticide during the summer when these pests are seen. (5) Paint the bark of infested branches with thick soap solution at any time the scales are found upon them.
	Leaf Blight, Shot-hole Fungus, Etc.	(1) Spray with Copper Sulphate or Iron Sulphate and Sulphuric Acid before the buds burst. (2) Spray with Bordeaux Mixture when the leaves first appear. Repeat No. 2 after the fruit has set and every two or three weeks or as often as is necessary to keep the Bordeaux Mixture on the trees and fruit until the latter is three-fourths grown. (3) After this use Cupram every week or two. Note that this is exactly the remedy for Brown Rot and practically all other diseases of leaves and fruit of nearly all plants here mentioned.

Plant.	Insects or Diseases.	Treatment.
	San José Scale, ...	Same treatment for this pest under "Apple." Remember the Plum is slightly more hardy than Peach and can stand a little stronger mixture if necessary.
	Slug, ...	(See remedy for "Cherry Slug.")
Poplar, ...	Caterpillars or Larvæ Eating the Leaves.	Spray with arsenites whenever any pests are seen devouring the foliage.
	Oyster-shell Scale, ...	(See treatment for this pest under "Apple.")
Potatoes, ...	Beetle or Colorado Potato Bug.	(1) Spray with arsenite whenever the insects are seen. (2) Or spray with a combined insecticide and fungicide after the middle of July for both the insects and the late blight or rot.
	Blister or Old-fashioned Potato Bugs.	(1) Spray as soon as they are seen with Arsenite of Lime or Arsenate of Lead. (2) Whip them into straw between the rows and burn the straw.
	Early Blight and Leaf Spot.	Spray with Bordeaux Mixture before the plants are half-grown and repeat this as often as is necessary to keep the material on the leaves.
	Late Blight and Mildew, ..	It is the Late Blight that strikes down the stem and causes potato rot. Spray with Bordeaux Mixture from the middle of July until the vines are nearly ripe, repeating once in two weeks or as often as it is washed off the leaves.
	Potato Rot, ...	Prevent the Late Blight by spraying with Bordeaux Mixture from the middle of July until the end of the growing season, or as often as is necessary to keep this material on the leaves. (2) If the blight should appear, mow or pull the blighted vines before the disease can strike down to the tuber.
	Flea Beetles, ...	These are small flea-like insects, generally dark in color that eat holes in the leaves while they are young. Spray early with Bordeaux Mixture, and an arsenite added, and keep this on the leaves. This will take the place of all other spraying, as the Bordeaux Mixture is a fungicide to prevent the various diseases of the potato and the arsenite is an insecticide to kill the other insects as well as this.
	Scab, ...	Soak seed potatoes in Corrosive Sublimate or Formalin, according to directions given in our Bulletins, and plant in soil that has not had the scab. It is necessary to avoid contaminated soil, even though the potatoes may be treated, and the germs adhering to them thus destroyed.
	Stalk-borer, ...	Gather and burn all stalks or vines immediately after gathering the crop.
Poultry, ...	Gapes, ...	(1) Keep young poultry from eating earth worms by (a) keeping them on board floors, (b) keeping them on gravel, or (c) using lime in abundance in the poultry yard to keep earth worms from coming to the surface of the soil. (2) Feed diseased chicks with corn meal containing turpentine in proportion of one teaspoonful to one pint. Shake the turpentine with water in a small bottle to mix it as much as possible and immediately pour it over the corn meal and stir well. (3) Make a horse-hair loop and insert this in the opening of the trachea or windpipe of the chicken, which can be seen at the middle of the base of the tongue, and by twisting and withdrawing it gap worms can be extracted.
	Lice, ...	(1) Lice on larger fowls can be killed by greasing them around the neck and head with lard or other grease, and especially rubbing this beneath the wing. Smaller chicks are relieved by using the large greased wings of the hens that brood them. (2) Dust the fowls well with Flowers of Sulphur, holding them by the feet and shaking it into the feathers while they are

PART II. PLANTS, PESTS AND TREATMENT—Continued.

Plant.	Insects or Diseases.	Treatment.
		held up-side down. (3) Dust them with a mixture of Hellebore, Pyrethrum and Flowers of Sulphur. (4) Supply them with abundant dust baths in which No. 2 or 3 are added.
	Red Mites or Red Lice, ...	(1) Use Sulphur in abundance or grease on the fowls. (2) Spray inside of the poultry house and especially the perches with the boiled Lime-sulphur Wash. (3) Wash the perches frequently with a heavy oil like Crude Petroleum to which a little Creolin is added. Clean the poultry house frequently.
Quince, ...	Borers, ...	Same treatment as for Borers of "Apple."
	Codling Moth, ...	Same treatment as for Codling Moth discussed under "Apple."
	Curculio, ...	Same as for "Plum Curculio."
	Blight, Fire Blight or Twig Blight.	Same treatment as "Blight of Pear."
	Leaf Blight, ...	(1) Bordeaux Mixture before the flower buds open. (2) Repeat this when fruit is set and as often thereafter as is necessary to keep the mixture on the leaves. (3) Spray with Cupram after the fruit is full size.
Raspberry, Blackberry. Dewberry.	Anthracnose or Canker of Stem.	(1) Cut out and burn all badly diseased vines. (2) Spray with Copper Sulphate before the leaves appear. (3) Spray with Bordeaux Mixture after the buds burst and repeat as often as is necessary to keep the mixture on the leaves until the fruit is two-thirds grown. (4) Cut and burn diseased vines immediately after gathering fruit.
	Orange Rust, ...	Cut out and burn all diseased plants, removing them by the roots and burning all parts. There is no remedy. Watch for the plants with conspicuous orange rust on the leaves, whether they be wild or cultivated and have them destroyed.
	Tree Cricket, ...	When the leaves are off, look for twigs pierced by the tree cricket in laying their eggs, and cut and burn them.
	Saw Fly or Slug, ...	(1) Spray with an arsenite, when the first leaves have expanded or the insect appears, and repeat in a few days or whenever the pests are seen. (2) Or dust with Hellebore or Air-slaked Lime and Paris Green.
Rose, ...	Aphis and Leaf Hoppers, ..	Spray with Kerosene Emulsion or Kerosene Mixture, or strong soap suds, or Tobacco Decoction whenever the pests are present, and repeat within a day if any remain alive.
	Black Spot, ...	From the time the leaves appear spray once per week with Cupram.
	Rose Bugs, ...	(1) Pick by hand and destroy. (2) Shake the bushes over cloths or sheets spread for the pests. (3) Cover the bushes with nets, especially at night. (4) Spray with Arsenate of Lead or Arsenite of Lime.
	Mildew, ...	(1) Spray with Cupram, or with Potassium Sulphide. (2) Fumigate greenhouses with Sulphur for Mildew.
	Red Spider, ...	Syringe with forceful jets of water or spray with Potassium Sulphide, or with Kerosene Emulsion and Sulphur.
	Rust, ...	(1) Destroy all diseased parts. (2) Gather and burn all dead leaves as fast as they are ready to fall. (3) Spray with Cupram (1) as soon as the leaves open, and once in two weeks thereafter.
	Slugs, ...	Give same treatment as for "Cherry Slug" and "Slug of Raspberry."
Strawberry, ...	Aphis on Roots, ...	Set clean plants upon land which did not grow strawberries or melons the previous year. Fumigate plants before setting them in order to kill the root lice, or dip them into Tobacco Decoction or Kerosene Emulsion. Plow under badly infested strawberry beds, and do not plant them in melons or corn.

PART II. PLANTS, PESTS AND TREATMENT—Continued.

Plant.	Insects or Diseases.	Treatment.
	Leaf Blight,	Spray with Bordeaux Mixture when the leaves first open in the spring, and repeat this just before the blossoms appear. Mow the strawberry bed as soon as the fruit is gathered, throw leaves together in a row between the plants and burn them.
	Leaf Roller,	Mow and burn as for "Leaf Blight."
	Saw Fly,	(See "Saw Fly" under "Raspberry.")
	Weevil,	No good remedy known. Pick off and burn drooping flower stalks and select and plant those varieties that are known as perfect, avoiding the purely staminate varieties.
Tomato,	Corn Worm and Cut Worm,	(See under "Corn.")
	Flee Beetle,	(See under "Potato.")
	Leaf Blight,	Spray with Bordeaux Mixture as for Early Blight of Potato.
	Potato Beetle,	(See under "Potato.")
	Rot,	Spray with Bordeaux Mixture as for Leaf Blight.
	Tomato Worm or Horn worm.	(1) Pick by hand and destroy. (2) Or spray with Paris Green or other arsenite if needed at any time before the fruit begins to ripen.
Violets,	Blight,	Spray with Bordeaux Mixture when first signs of disease are seen and repeat as generally directed for Bordeaux. Remove and burn affected leaves.
	Mildew,	Spray with Potassium Sulphide.
	Red Spider,	Same treatment as for Red Spider on "Rose."
Wheat,	Aphis or Wheat Plant Louse.	If sufficiently abundant spray with Tobacco Decoction, Soap Solution or Oil Emulsion, using a small or knapsack sprayer.
	Hessian Fly,	(1) Plow down infested stubble. (2) Or burn infested stubble. (3) Plant a trap strip during the early part of August along the side of the field that is to be planted in wheat. Plow this trap strip under during the second week of September, and plant the main crop after September 20th for the northern part of the State, 25th, for the central part, and 30th for the southern part. (See our Special Bulletin on "Hessian Fly.")
	Smut,	Treat seed wheat with Corrosive Sublimate or Formalin.
	Wheat Midge,	(1) Plow deep soon after harvest. (2) Be careful to burn or feed all cleanings at threshing time.
	Wheat-head Army Worm,	Preserve the small snakes, turtles and birds, especially Wrens and Bluebirds. Kill the Army Worms by spraying with arsenical poison when they are quite young, and also when few in numbers, if possible. After the Army Worm has started to march destroy it by one of the following means: (1) Spray vegetation along the front line of its march with arsenical poisons. (2) Spray the worms themselves with strong contact poisons such as very strong soap solution, strong tobacco decoction, crude petroleum, kerosene, or kerosene emulsion or mixture. (3) Plow a strip of ground immediately in front of their line of march and keep the harrow moving over it. (4) Plow a double furrow just in front of them, and by means of a horse drag a log back and forth in this furrow. (5) Plow a furrow with the steep or vertical side from the worms and toward the crop to be protected and dig a number of holes like post holes at intervals in this furrow. The worms will be unable to ascend the vertical side and in crawling along the furrow will drop into the post holes and die. (6) Plow a furrow and put in it a stream of tar or crude petroleum. (7) Plow and cultivate the ground to destroy them after they enter the soil, about midsummer.

PARASITES OF SCALE INSECTS.

The most noticeable feature of insect pests is their abundance in numbers or outbreaks during some years and their apparent absence during other years. Were insect pests to increase without check for five years the earth would be by no means inhabitable. Very few persons comprehend the cause of the sudden disappearance of insect pests and its significance to the agriculturists. However, this is generally due to parasites or adverse climatic conditions, for the most cases are due to the development in great numbers of parasites or beneficial insects which destroy the obnoxious species.

The parasites of insects may be grouped as (1) predaceous insects, or those that capture and feed upon others, among which are the Ground Beetles, the Robber-flies, the Bedbug-Hunter and many others; (2) the external parasites which live upon the body of the host while it yet exists, such as the Bee Louse, and (3) the internal parasites which develop from eggs laid by the mature insect, either upon or in the body of the host or pest, and which during their larval or immature stages feed upon the tissues of the host, avoiding the really essential or vital organs, and thus not producing immediate death. The parasitized insect or host may have enough vitality to complete its own growth, but it dies before transforming to the mature stage, and consequently before laying its eggs and reproducing its kind.

The internal parasites are, of course, remarkably small, and generally have no common names, but many are often regarded as gnats. They multiply rapidly when their hosts are abundant, and soon result in effectually suppressing insect outbreaks.

On account of the great numbers of the internal parasites in the larger scale insects, such as the Oyster-shell Scale, the Scurfy Scale and the Turtle-shell or Lecanium Scale, these common and long-known pests are held in subjection and rarely become, for any considerable length of time, so numerous as to be of serious consequence. Where such pests develop in great numbers there the parasites, chiefly of the internal species, may be seen multiplying. It is not uncommon for us to receive at this office specimens of Oyster-shell, Scurfy and Lecanium or Turtle-shell Scale Insects that are punctured by fine holes, looking as though needles had been put through them. These holes were made by the parasites, which fed in them, came to maturity, emerged and flew away, seeking other scale insects in which to deposit their eggs. We have observed a

definite example in the Maple trees along the streets of the city of York, which were infested with Oyster-shell Scale, but saved by the agency of the internal parasites of that pest.

Among the scale insects sent to this office was a species of Lecanium on Mulberry, our specimen No. 788, sent by Mr. F. C. Stokes, of Philadelphia, Pa., which was kept in one of our breeding cages for the purpose of obtaining the parasites which were puncturing it. From this particular specimen of scale insect, shown slightly enlarged in Plate IV, lower left corner, there eventually appeared two species of these very small parasites, which are also shown in Plate IV, magnified thirty diameters. These have no common names, but Figure a is known by the scientific name *Coccophagus immaculatus* Howard, and Figures b and c are known by the scientific name *Pachyneuron micans* Howard.

We have also bred the last-named species from Lecanium on Jersey Scrub Pine (*Pinus inops*).

The former of this species of beneficial insect is known to be an enemy of the Wheat Aphis and also of the Aphis injuring grass.

Plate V, Figure A, shows another species of these internal parasites (*Physcus varicornis* Howard), magnified sixty-five diameters, which we developed from Scurfy Scale (*Chionaspis furfura*), attacking *Pyrus japonica*. This is from our specimen No. 5211 a, contributed by the Zoological Society of Philadelphia. It is thus seen that most scale insects are parasitized and held in check by their minute enemies, and this is why they have not been so permanently destructive as has the San José Scale. The last-named pest is so very small that these minute parasites, as little as they are, do not find within its body enough substance to bring them to maturity, and consequently it is almost free from internal parasites and not held in check by the agencies that cause nearly all other of our insect pests to come and go in outbreaks such as are often seen.

Plate V, Figure B, shows a common predaceous insect, a Lace-wing (*Chrysopa oculata*) and its eggs on their tall stalk, and also its cocoon or resting stage, magnified two diameters. The larva of this Lace-wing is one of the most beneficial insects, because it is an important enemy of young scale insects and plant lice.

POTATO BLIGHT AND ROT.

It should be remembered that the first spraying for Potato Blight which produces the rotting of the tuber should be made about the last of June. For good results and to prevent Potato Rot certain facts should be remembered. There are two kinds of Potato Blight,

one known as the Early Blight appearing about the middle or last of June, and the other known as the Late Blight appearing during July and August. Both are definite disease conditions of plants due only to disease germs, which enter the tissues of the plant through the leaf or tender part of the stem, and cause it to break down or die and turn brown or dark.

The Early Blight does not produce or result in the rotting of the tuber or potato, although it does a great deal of damage by destroying the plants before the potato is grown. It does not appear to be held in check as readily by Bordeaux Mixture as is the Late Blight, although it is well worth while to spray for both. It should be remembered that in spraying for these, as for other plant diseases, the fungicide is applied as a preventive and, therefore, should be put on the plants before the diseased condition appears, and kept upon them constantly, so that when the disease germs fall on the leaves and start to develop their very delicate and tender substance comes into contact with the fungicide and their vitality is destroyed.

It is now definitely known that Potato Rot is due to or follows the Late Blight. The blight germs enter the leaves which become dark and wither, and this blighted condition extends down the stem and into the tuber. It may rot in the field or the germs may remain in it until it is taken into the barn or cellar and rot there. The best preventive is to spray for Late Blight beginning not later than the last of June, using the Bordeaux Mixture, and applying this at least once every two weeks and repeat after every rain that is hard enough to wash it off the leaves. The object is to keep a very thin film of the Bordeaux Mixture over the leaves all the time, so that the blight germs can not fall upon them without coming into contact with this fungicide and being killed in the process of their development.

It is best to do the spraying with a field sprayer attachment, which means a horizontal pipe extending over the rows, with the pipes reaching down to the potato vines and with one or two nozzles, and permitting the liquid to come as a spray on each side of the row. The pipes can be arranged in such a manner that four or five rows can be sprayed at one time. The best apparatus for the work is an outfit geared with wheels in such a way that the power is generated by driving along. This wheel gearing is especially suitable for spraying trees, excepting where they are very small. The reason for this is that in spraying trees the apparatus stands still and the power runs down to such an extent as to do poor work or become useless, without driving for the purpose of increasing the pressure, while in spraying field crops the power is generated regularly by the turning of the wheels, and the pressure is steady in forcing the liquid through the nozzles in a regular uniform spray.

If a field spraying outfit be not available it is possible to do first class work in a potato field by spraying with an ordinary barrel spray pump, such as is used for orchard work. This can be mounted on a cart or on a wagon in such a way that the pipes and nozzles may extend down over the rows, and the power for the spraying can be produced in the regular way by a man at the handle of the pump.

Make the Bordeaux Mixture by using four pounds of Bluestone and six pounds of Lime in fifty gallons of water. Dissolve the Bluestone in a wooden vessel or merely suspend it in a bag at the top of a barrel of water during the night. If it is thrown to the bottom of the barrel it will not dissolve nearly as readily as to suspend it near the surface of the water. Do not use a metal vessel for dissolving or carrying the Bluestone solution. Slake the Lime and add water to make a milk of Lime, then strain it through a fine strainer, the same as for San José Scale spraying, and pour the Lime water into the dilute Bluestone solution, and this is the Bordeaux Mixture, made by the four-six formula. If Potato Beetles or other chewing insects be present they can be killed by adding one-half pound of Paris Green to every fifty gallons of this mixture. Add Paris Green to any liquid by putting it into a small vessel like a tin can or bowl, and add enough water to make it mushy when well stirred, and stir it until it is made into a paste, then rinse it into the liquid, and it will be carried through all parts. If it be added dry to a barrel of liquid, it is quite difficult to get it to enter into the liquid itself, as it will persist in remaining on top in the form of small dry lumps. It is not necessary to add Paris Green to the Bordeaux Mixture, excepting when chewing insects are present or liable to appear soon. If Arsenate of Lead be preferred or more convenient, it will be found an excellent poison, and will stick better in solution than will Paris Green, and should be used at the rate of two pounds to fifty gallons of water or Bordeaux Mixture.

There is no doubt whatever of the possibility of properly controlling and preventing the Late Blight and Rot of Potatoes by spraying regularly with the Bordeaux Mixture. One correspondent has written to this office that by comparison of the yields of sprayed and unsprayed portions of his large potato field, he found that he has saved one hundred and sixteen dollars ($116.00) worth of Potatoes per acre by spraying for this disease.

SPECIMENS RECEIVED DURING MAY 1907.

Number.	Specimen—Insects.	Date—May, 1907.	Name and Address.
9010	(a) Scurfy Scale,, ...	1	C. C. Haldeman, Danboro.
	(b) San José Scale, ...		
9011	Stone Flies (Pteronarchys regalis),....	1	G. R. Styer, Berwick.
9012	Oyster-shell Scale, ...	1	I. C. Gahagan, Smicksburg.
9013	Rose Scale, ...	1	J. E. Patterson, Wilkes-Barre.
9014	(a) Katydid Eggs, ...	1	I. C. Elder, Chambersburg.
9015	Oyster-shell Scale, ...	1	J. Mosier, Saegerstown.
9018	Oyster-shell Scale, ...	2	R. Felty, Onset.
9019	Giant Water Bug (B. griseus), ...	2	G. W. Gelwicks, Rutherford.
9022	(a) Cecropia Cocoons, ...	2	G. VanNieda, Womelsdorf.
	(b) Promethea Cocoons, ...		
9023	Oyster-shell Scale, ...	2	S. E. Firth, Lansing.
9025	(a) Lecaniodiaspis tessellata, ...	2	M. M. Haines, Cheltenham.
	(b) Sessile larvæ, ...		
9026	Oyster-shell Scale, ...	2	E. Welles, Wilkes-Barre.
9030	Insects, ...	3	H. W. Anderson, Stewartstown.
9031	Stone Fly (P. regalis), ...	3	Mrs. G. P. West, Danville.
9036	Oyster-shell Scale, ...	3	G. R. Pritchard, Harrisburg.
9038	Terrapin Scale (E. nigrofasciatum), ..	4	A. M. Yingling, Altoona.
9040	Giant Water Bug, ...	4	H. Z. Wampole, Telford.
9043	San José Scale, ...	4	A. S. Smith, Everett.
9051	Biting Louse, ...	6	Isaac DeWalt, Allentown.
9052	Oyster-shell Scale, ...	6	W. E. S. Uber, Clark's Mills.
9053	Water Beetle, ...	6	H. Schick, Camp Hill.
9056	Oyster-shell Scale, ...	6	A. R. Greenwalt, Kempton.
9062	Beetle (Anatis ocellata var.), ...	7	D. W. Bohn, Robesonia.
9063	Eyed Elater (A. oculatus), ...	7	P. V. James, Philadelphia.
9064	San José Scale, ...	7	J. H. Patterson, Athens.
9066	Scurfy Scale, ...	8	J. R. Sleek, New Paris.
9068	Long-horned Beetle (Monohammus titillator), ...	8	E. J. Nisley, Penbrook.
9070	Oyster-shell Scale, ...	8	F. Keith, Eagle Foundry.
9071	(a) Rose Scale, ...	8	C. F. Hays, Curwensville.
	(b) Oyster-shell Scale, ...		
9072	(a) Oleander Scale (Aspidiotus hederæ), ...	8	J. E. Patterson, Wilkes-Barre.
	(b) Cecropia Cocoon, ...		
9073	Oyster-shell Scale, ...	8	E. Welles, Wilkes-Barre.
9074	Oyster-shell Scale, ...	8	B. F. Rinehart, West Moshannon.
9076	(a) Scurfy Scale, ...	8	Dr. W. B. Cathcart, Mt. Pleasant.
9078	Syrphid Fly Pupa, ...	8	E. Stoner, Ephrata.
9080	Lecaniodiaspis tessellata, ...	9	F. W. Floyd, Dillsburg.
9084	Polyphemus Cocoon, ...	9	C. F. Sander, Millersville.
9093	Wireworm, ...	10	H. S. Webb, Scranton.
9094	Water Scavenger Beetle (Hydrophilus triangularis), ...	10	Miss I. Dunkle, Harrisburg.
9095	H. triangularis, ...	10	H. Barrington, Harrisburg.
9097	San José Scale, ...	10	E. D. Swartz, Markelsville.
9098	(a) Buffalo Carpet Beetle (Anthrenus scrophulariæ, ...	10	Miss M. Blackford, Freeport.
	(b) Clothes Moth tubes, ...		
9101	(a) Giant Water Bug, ...	10	C. N. Greene, Troy.
	(b) Water Beetle (Dytiscus fasciventris), ...		
9106	Oyster-shell Scale, ...	11	N. L. Keirn, Hastings.
9107	Diptera larvæ Prob. Anthomidæ, ...	11	Miss B. M. Kimball, Westfield.
9108	Oyster-shell Scale, ...	11	H. W. Frey, Oil City.
9110	Insects, ...	13	G. R. Pritchard, Harrisburg.
9117	(b) Scurfy Scale, ...	13	J. W. Ipher, Renton.
9118	Oyster-shell Scale, ...	13	L. P. Kerner, St. Marys.
9120	H. triangularis, ...	13	W. K. Warden, Oxford.
9123	Roach Egg Case, ...	13	A. I. Root Co., Medina, O.
9134	(a) Cicada Egg Punctures, ...	14	J. W. Fryling, Sunbury.
	(c) Psyllidæ on Sumac, ...		
9135	Oyster-shell Scale, ...	14	S. C. Snyder, New Millport.
9137	Scurfy Scale, ...	14	C. H. Smith, Cove Forge.
9138	Oyster-shell Scale, ...	14	W. P. Fraser, Pittsburg.
9139	Oyster-shell Scale, ...	14	F. W. Boyer, Pottsville.
9140	(a) San José Scale, ...	14	G. A. Hoagland, Bedford.
	(b) Twice-stabbed Lady Beetle (Chilocorus bivulnerus), ...		
9145	Plum Scale (Eulecanium prunastri), ..	15	J. H. Moyer, Muncy.
9146	Giant Water Bug, ...	13	T. E. Moore, Grampian.
9147	San José Scale, ...	15	W. C. Baird, Ashtabula, O.
9148	Oyster-shell Scale, ...	15	Capt. S. Martin, Erie.
9149	Insects, ...	15	W. H. McElwee, Harrisburg.

Number.	Specimen—Insects.	Date—May, 1907.	Name and Address.
9153	Giant Water Bug,	17	J. H. Sherk, Fredericksburg.
9159	Oyster-shell Scale,	17	N. J. Wells, Tunkhannock.
9161	San José Scale,	17	H. K. Miller, Huntsdale.
9164	(a) Wasp, (b) Sesiid Pupa,	18	G. R. Pritchard, Harrisburg.
9166	(c) Sphinx Pupa,	18	R. L. Jackson, McConnellsburg.
9167	(a) Giant Water Bug, (b) H. triangularis,	18	A. J. Rice, Easton.
9168	(c) Giant Water Bug,	18	H. Schick, Camp Hill.
9172	Ox Warble larvæ,	20	I. DeWalt, Allentown.
9174	Clothes Moth,	20	H. E. Weithnecht, Siegfried.
9182	Aphids,	20	S. T. Davis, Lancaster.
9183	Oyster-shell Scale,	20	W. L. McCracken, Brookville.
9184	(a) Oyster-shell Scale,	20	W. D. B. Ainey, Montrose.
9185	(a) Scurfy Scale,	20	Oberlin Bros., Rochester Mills.
9187	Chrysomelid Beetles,	20	A. Deming, Lawrenceville.
9188	(a) San José Scale,	20	A. M. S. Hamilton, Cochranville.
9190	Scurfy Scale,	20	C. C. Bowman, Pittsburg.
9191	(a) June Bug (Lachnosterna sp.), (b) Scurfy Scale,	20	L. M. Kerlin, Liverpool.
9202	Giant Water Bug,	21	F. S. Henry, Philadelphia.
9203	San José Scale,	21	H. Justice, Philadelphia.
9204	Beetle (Ips 4-guttatus),	21	W. H. VanFleet, Factoryville.
9207	(a) Lady Beetle (Megilla maculata), (b) Saw Fly,	21	P. S. Tooker, Easton.
9209	Work of Beetles Prob. Cerambycidæ,	22	L. Kraemer, Reading.
9212	Terrapin Scale (E. nigrofasciatum),	22	W. R. Crabbe, Pittsburg.
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9231	(a) Cecidomyia Larva,	27	C. J. Rich, Woolrich.
9232	Aphids,	27	H. H. Plank, York Springs.
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9236	(a) Tiger Beetle (Cicindela 6-guttata), (b) Noctuid Pupa,	27	W. C. Dickson, Wayne.
9239	San José Scale,	27	A. H. Sinsabaugh, Wyalusing.
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9184	(b) Mites,	20	W. D. B. Ainey, Montrose.
9185	(b) Mites,	20	Oberlin Bros., Rochester Mills.
9227	(b) Mites,	27	F. W. Sheldon, Susquehanna.
9231	(b) Mite Eggs (?),	27	C. H. Rich, Woolrich.
9235	(d) Mites, (e) Pseudiscorpion,	27	C. A. Row, Langhorne.
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9257	Leech,	31	F. L. Witherup, Emlenton.
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9005	Blacksnake (B. constrictor),	1	Miss B. VanSant, George School.
9006	Common Garter Snake,	1	R. F. Miller, Frankford.
9007	(a) Blacksnake,	1	J. D. Richard, Barton.
9008	(a) 3 Sculptured Turtles (Clemmys insculptus), (b) Common Garter Snake, (c) Green Frog (Rana clamitans), (d) 3 Leopard Frog (Rana pipiens),	1	R. W. Wehrle, Indiana.
9016	Common Lizzard (Sceloporus undulatus),	2	L. B. Small, Marion.
9020	Grass Snake (L. vernalis),	2	J. F. Beecher, Kerrsville.
9021	Common Garter Snake,	2	C. Bruckart, Lititz.

Number.	Specimen—Insects.	Date—May, 1907.	Name and Address.
9024	Ribbon Snake (T. sauritus),	2	L. S. Pearson, Wayne.
9032	Blowing Viper (H. platirhinos),	3	J. S. Landis, McCulloch's Mills.
9033	Common Box Tortoise (Terrapene carolina),	3	A. G. Wanner, Ephrata.
9035	Ground Snake (C. amoenus) 3 ——, ——		
9059	(a) 2 Speckled Turtles (Clemmys guttatus),	7	C. L. Gruber, Kutztown.
9060	(a) Common Box Tortoise, (b) 3 Hellbenders (Cryptobranchus alleganiensis), (c) Water Dog (Necturus maculosus), (e) 5 Green Frogs (Rana Clamitans) (f) 3 Leopard Frogs,	7	R. W. Wehrle, Indiana.
9061	Frog Eggs,	7	F. W. Hagenbuch, Danville.
9065	(a) 3 Rock Snakes (S. dekayi),	8	B. Ditzel, Harrisburg.
9079	(b) 4 Brown Salamanders (Desmognathus fusca),	9	J. T. Black, Glenhope.
9081	Queen Snake (R. leberis),	9	R. W. Wehrle, Indiana.
9087	(a) House Snake (L. d. triangulus),	10	W. L. Mosebey, Wells Tannery.
9088	Common Garter Snake,	10	G. M. Lehman, Essington.
9089	(a) Red Salamander (Spelerpes ruber). (b) 2 Granite Salamanders (Plethodon glutinosus),	10	W. F. Dague, Mont Alto.
9090	(a) 2 Common Box Tortoises,	10	P. S. Tooker, Easton.
9103	Common Water Snake (N. sipedon),	10	A. Shelly, Harrisburg.
9105	(a) Red Salamander, (b) 2 Brown Salamanders, (c) Meadow Frog (Rana palustris),	11	W. H. Bullock, Honesdale.
9111	Blowing Viper,	13	W. E. Vallerchamp, Duncannon.
9112	Common Garter Snake,	13	I. F. Zook, Ronks.
9114	House Snake,	13	M. M. Haines, Cheltenham.
9115	(a) Grass Snake, (b) Rock Snake, (c) 2 Green Frogs, (d) 12 Newts (Diemictylus viridescens),	13	F. B. Keboch, Williamstown.
9126	(a) 2 Red Salamanders, (b) Brown Salamander,	13	State Museum, Harrisburg.
9128	Rock Snake,	14	A. Hartwick, Harrisburg.
9129	House Snake,	14	E. E. Steizerwalt, Bowmanstown.
9131	(a) Common Garter Snake, (b) Ribbon Snake,	14	H. A. Brightbill, Jr., Marsh Run.
9132	Common Lizard,	14	J. C. Suskey, Harrisburg.
9133	4 Common Lizards,	14	W. L. Mesebey, Wells Tannery.
9141	(a) Common Garter Snake, (b) Brown Salamander, (c) Sculptured Turtle,	14	H. L. Meredith, Harrisburg.
9143	(b) 3 Common Garter Snakes,	15	R. W. Wehrle, Indiana.
9144	(a) 4 Rock Snakes, (b) 1 Common Garter Snake, (c) 1 Common Water Snake,	15	R. F. Miller, Philadelphia.
9151	House Snake,	16	C. A. Palmer, Warfordsburg.
9154	House Snake,	17	C. A. Palmer, Warfordsburg.
9155	Black Snake,	17	R. W. Wehrle, Indiana.
9157	King Snake (Lampropeltis getulus sayi),	17	J. Hand, Jr., Belleplain, N. J.
9166	(a) 2 Green Frogs, (b) 1 Meadow Frog, (d) Miller's thumb (Cottus gracilis?),	18	R. L. Jackson, McConnellsburg.
9168	(a) Green Frog,	18	H. Schick, Camp Hill.
9175	Grass Snake,	20	Dr. O. W. H. Glover, Laureiton.
9176	Common Water Snake,	20	J. B. Richard, Barto.
9192	Rock Snake,	21	R. Belstline, Harrisburg.
9193	(a) Green Frog, (b) Common Box Tortoise, (c) Copperhead Snake (A. contortrix), (d) Pilot Snake (C. obsoletus),	21	R. W. Wehrle, Indiana.
9194	Common Garter Snake,	21	G. W. Wimmer, Nazareth.
9195	(a) Purple Salamander (Gyrinophilus porphyriticus), (d) 2 Brown Salamanders,	21	R. I. Myers, Welty.
9196	(a) Common Water Snake, (b) Black Snake,	21	S. B. Harstine, Ferndale.
9197	(a) Common Water Snake, (b) Common Garter Snake,	21	D. M. Hovis, New Franklin.
9198	House Snake,	21	H. A. Brightbill, Marsh Run.
9199	Speckled Turtle,	21	W. C. Dickson, Wayne.
9208	(a) 2 House Snakes, (b) Common Lizard,	22	G. and Mc. Landis, McCulloch's Mills.
9213	Common Garter Snake,	22	R. D. Spencer, Williamsport.

THE MONTHLY BULLETIN OF THE DIVISION OF ZOOLOGY FOR JULY, 1907.

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OUR MONTHLY CHAT WITH READERS.

* * * Re-organization of the Office Force of the Division of Zoology.—The Economic Zoologist takes pleasure in announcing to the public the present organization of his office corps of helpers, for it is upon the energy and faithfulness of these that we must depend for successful results.

The present Assistant Economic Zoologist is Mr. A. F. Satterthwait, of Chester county, who has had practical experience upon the farm and scientific training in the Philadelphia Academy of Sciences and also in the Pennsylvania State College. The present Clerk is Mr. W. R. McConnell, of Indiana, Pa., who was graduated from the Pennsylvania State College in 1906, and taught Zoology and kindred subjects in that institution during the past year. The Chief Stenographer is Miss Kathryn P. First, of Harrisburg, and the Messenger is Mr. J. D. Hipple, of Middletown. In addition to these persons, whose offices are named by legislative enactment, there is a Chief Nursery Inspector, Mr. E. B. Engle, of Waynesboro, and about twenty investigators, inspectors and demonstrators.

* * * Directions for Collecting.—We have received so many requests for re-publishing in one number of our Bulletin, the "Directions for Collecting and Preserving Insects," that we have decided to do this in the September number of this volume. This is particularly justifiable in consideration of the fact that the previously issued Bulletins containing these directions have been exhausted, and teachers and pupils are particularly desirous of making and preserving collections, beginning with the scholastic year.

* * * Turtles and Lizards Wanted.—As readers of these Bulletins know, we have commenced a series of investigations and publications upon the Animal Life of Pennsylvania. The Serpent Bulletin was published in September of last year, and for this publication there has been such a demand that the supply is now exhausted, and we contemplate a Second Report on "The Serpents of Pennsylvania" next year. At the present time, while our efforts are being given chiefly to the Entomology of the State, we are paying some attention to the study of Turtles and Lizards, as two of the Orders of the general Class of Reptiles, and it is our desire to procure enough material at once to make it possible to publish in October of this year a Bulletin upon "The Turtles and Lizards of Pennsylvania." We, therefore, request all persons who can do so to kindly aid by sending us, at once, specimens of these two Orders of Reptiles. We greatly prefer to have them killed, in order that the stomach contents will be preserved and we can determine what they have been eating in their wild state. It is an easy matter to

procure chloroform from almost any drug store, and put this into a tightly closed small vessel with the specimen to be killed. Leave it closed about a half hour, and the animal will be found dead or insensible. If insensible, it can be killed by piercing its brain or heart with a sharp needle, and if Turtles are found difficult to chloroform, an excellent way to treat them is to inject chloroform into their lungs by a hypodermic injection (through the skin) back of the forelegs. Send larger packages by express at our expense, or smaller packages by mail, when postage will be refunded. Please do not send dead animals by mail during warm weather, when they spoil in transit.

As with the Serpent Bulletin, of which the supply is now unfortunately exhausted, and for which requests are daily made in vain, we are obliged to announce that the first copies of the new Turtle and Lizard Bulletin issued from this office, will be mailed to those persons who have aided the work by sending us specimens or notes upon these subjects. After our correspondents and contributors are supplied with their promised Bulletins, the publication will be sent to others requesting it until the supply will have been exhausted, after which time a second edition will not be issued, and other copies will not be available. Consequently the sure way to receive a copy of the forthcoming Bulletin upon the Turtles and Lizards of Pennsylvania is to act upon the above suggestion and send to this office specimens to aid in these studies. They must be sent very soon in order to reach us in time to be useful in the studies which we are now making.

Notes or communications upon Turtles and Lizards are also desired, and will be given the same consideration in regard to the mailing list as specimens sent to us. Any person who desires further directions for collecting, killing or sending specimens is invited to write directly to the office of the Economic Zoologist.

* * * Insects Wanted.—We are working upon a complete Catalog of the Insects of Pennsylvania, with notes on dates and localities of occurrence, food, enemies and economic features and remedies. This is a stupendous task, and the details of the plans are not yet ready for publication, but it is enough to say that several specialists will be associated with us in the preparation of such a Catalog. It may be a year or more until it is completed, and consequently it is not advisable for persons to write now for it, but we make this announcement at this time to invite all interested persons to continue sending specimens of Pennsylvania insects to this office. Every specimen will be acknowledged, properly preserved, identified and used in further studies and publications.

Please address all specimens, notes and inquiries to H. A. Surface, Economic Zoologist, Harrisburg, Pa.

A GENERAL SYSTEMATIC STUDY OF INSECTS—PART III.

In our Monthly Bulletin for January, 1906, Vol. III, No. 9, page 274, we commenced "A General Systematic Study of Insects." In that Bulletin was published a brief discussion of the Arthropoda, or "Joint-footed" Animals, and a fuller treatise of Hexapods or Insects, and the relationship of the three other classes making up the Sub-kingdom. We there published concerning the various Orders of Hexapods, or Insecta, such as the Fish Moths, May Flies, Dragon Flies, Stone Flies, White Ants, Book Lice, Bird Lice, Earwigs, and Orthoptera or so-called "Straight-winged" Insects. The last Order was concluded on page 292. This subject was resumed in Vol. IV, No. 2, for June, 1906, page 48, giving a preliminary discussion of the Order Hemiptera or Bugs, and completing the study of the Sub-order Heteroptera or "True Bugs," on page 72 of Vol. IV.

As was shown on page 49, the Order Hemiptera includes three Sub-orders, which are to be recognized by the following analytic key:

A. Hemiptera with or without wings, but with jointed beak.

B. First pair of wings thickened at the base, with thinner extremities, which overlap flat on the back; beak arising from the front part of the head. Sub-order A. Heteroptera. The True Bugs, p. 49.

BB. Wings all thin and transparent (of the same thickness throughout) and usually sloping at the sides of the body; beak arising from the hinder part of the lower side of the head. Sub-order B. Homoptera. Cicadas, Plant Lice, Scale Insects, etc.

AA. Wingless Hemiptera, with fleshy jointed beak, parasitic upon man and other mammals. Sub-order C. Parasitica. The Lice.

Sub-order D. Homoptera. The Cicadas, Leaf-hoppers, Aphids, Scale Insects, etc.

The insects of this Sub-order vary greatly in form and appearance, but all live on the juices of plants, sucking them with the sharp beak or proboscis, and consequently all are injurious to vegetation. One species is important as an article of commerce, this being the Cochineal Scale Insect, of Mexico, which is collected by scraping it from the cactus plants which it infests, and is dried and sold without any further preparation. It is used as a red coloring matter for cakes, candies, etc.

The beak of the Homoptera is attached to the hinder edge of the lower side of the head, and although these insects do not all have wings, nearly all which do possess them, hold them sloping like the

roof of a house when at rest, and the upper or front wings are of equal thickness, or the same texture, from base to tip. In this way they are to be distinguished from the representatives of the Sub-order Heteroptera, discussed in the last Bulletin on this subject. As these are suctorial insects, they are not to be killed by arsenical or other internal poisons, and must be attacked by external applications if at all.

The Homoptera agree with the two other Sub-orders of Hemiptera or Bugs in having incomplete metamorphosis or three distinct stages in their life history, represented by the egg, nymph and adult or mature insect. Thus there is no pupal stage or chrysalid, excepting in the male Scale Insects which represent the peculiar condition of complete metamorphosis or the four stages. The nymphs or young are very much like the parents or adult insects, excepting that they are smaller in size and do not have wings. At first the wing pads are absent, but after molting a few times the little pads or elements of wings are visible, and after further molts the wings appear, and the insect has assumed the adult condition. They are unable to fly excepting in the last-named stage, and when the young or wingless forms are found in numbers on any plant it may be taken as practically certain that they are feeding on this particular kind of plant.

Homoptera further agree with all the other species of Hemiptera or Bugs in having only sucking mouth parts, entirely unfitted for chewing or biting, and they are thus compelled to take their nourishment by piercing the plants and sucking the sap from them. They often inject a liquid or saliva into the plant, which may poison it more or less. Infested leaves often curl and thus form protecting covers within which the pests revel. Of course, being suctorial insects they are to be killed only by contact applications, as they do not commence to take their nourishment until after the bill is inserted into the food plant, and consequently can not be affected by arsenical or other internal poisons, such as are to be sprayed on the surface of leaves and fruit for chewing insects.

Remedies.—The remedies for these sucking insects must necessarily be of a nature to kill by contact and must be included in the oils, soaps, caustic solutions, gases, dusts and decoctions. The internal insecticides, such as those mentioned in the May Bulletin from Formula No. 13 to 22 inclusive will not destroy them. Among the contact applications, Kerosene Emulsion raised until about ten per cent Kerosene is used, will give good results, as will also Kerosene Mixture. Whale Oil Soap, used one pound to six gallons of water, and ordinary laundry soap, one pound dissolved in four gallons of water, are also good. Tobacco Decoction, Formula No. 49, is useful as well as the various powders, such as Hellebore, Pyrethrum and other

good insect powders when fresh and applied either as a dust or decoction. Fumigation with Tobacco is a standard remedy for such pests in greenhouses, while the Hydrocyanic Acid Gas, Formula 35, is one of the best remedies. Sulphur is extensively used in fumigation, as are also the fumes of Pyrethrum and other powders. Of course, fumigation can not be successfully employed excepting where the infested plants can be tightly enclosed in a room, tent or vessel.

Care should be taken to avoid confusing the strength of the winter formula with that of the summer formula, and applying any material so strong as to destroy the foliage by using a remedy that was intended for use in winter or for dormant trees only.

FAMILY 1. Cicadidæ. The Cicadas or Locusts.

Few insects are better known, at least by reputation and reference in stories and Scripture, than the Cicadas or so-called "Locusts," although on the other hand, very few are so little understood and so commonly and unjustly misrepresented.

The insects of this family properly should be known as Cicadas rather than Locusts. The creatures that properly should be called "Locusts" are the "Short-horned Grasshoppers," or Acrididae, discussed on page 288 of Vol. III. Many stories have been told and published concerning Locusts destroying crops, which are based upon the occurrence of this Grasshopper rather than the Cicada, and there is no doubt of the fact that the Locusts in the Scripture, which "came in devouring hordes," were Short-horned Grasshoppers instead of Cicadas. The "Kansas Locust" is also a Grasshopper, and not a Cicada.

As was shown in a previous Bulletin, the Grasshoppers or Acrididae have heavy jaws, and devour a great deal of vegetation, while the Cicadas have only finely pointed beaks, and in most cases never insert them into vegetation nor suck juices, and are entirely unable to devour or eat away any of the tissue of the plant. The Cicadas have large bodies and comparatively small, broad heads, with prominent eyes. The males of some species are capable of producing a remarkably loud, shrill noise, while the females are silent.

The most remarkable thing concerning the Cicadas is their periodicity of appearance. For example, the one commonly seen during the summer time, known as the Dogday Harvest Fly (Cicada tibicen), is the "Two-year Locust." Although they require two years for development, there is a brood each year, and as these overlap it gives to the observer the appearance of an annual brood.

The Seventeen-year Cicada, or so-called Seventeen-year Locust (Tibicen [Cicada] septendecim), appear at regular intervals of seventeen years in the North and sometimes only thirteen years in the South, with such precision that many persons have wondered how the

insects are able to time themselves in the ground with accuracy during the long stay of many years. The life history of the Seventeen-year Locust (Tibicen [Cicada] septendecim) is as follows (See Plate VI.):

wood of some tree, and as the young hatch they drop to the ground, enter it, and feed upon the sap of the roots of trees and bushes. Their growth is, of course, very slow, as is shown by the fact that at the end of five years they are only about the size of a full grain of wheat. During the spring of the seventeenth year they start upward toward the soil, and when the weather is favorable they bore their way out of the ground, and climb the trunks of trees or posts, where they fix themselves firmly with their feet. Next along the back there appears, in the outer hull, a split or cleft, through which the newly winged insect crawls, very soft, white and delicate. After remaining thus a few hours, its wings become strengthened to such an extent that it is able to fly. No one knows just what kind of time-table Nature is able to keep for an insect with such a remarkable development, but the statement that the insect bores down into the ground for eight years, takes one year to turn around, and eight more years to return to the surface of the ground is, of course, quite erroneous, and is merely a crude popular effort to explain the cause of the interval of seventeen years.

After becoming winged they fly and become quite noisy in the trees and bushes. Their noise sounds very much like the croaking of a great many frogs, and we have known it to be mistaken for that of frogs. They lay their eggs in the branches of woody plants, and sometimes also pierce berry bushes, and even weeds or other low plants. The only damage they do to vegetation is at the time they are depositing their eggs, and this is caused by the rasp-like saw with which they tear away the bark of the wood and enter in the branch. This means that, like many other insects, they may take no food whatever after becoming mature or winged.

Although we have made no special effort to compile a full list of the species of plants attacked by the Seventeen-year Cicada, we have recorded thirty-five varieties, as published below, seventeen of which were sent, with specimens, by Mrs. G. P. West, of Bald Top, Pa: Apple, Ash, White Aster, Azalia, Blackberry, Currant, Chestnut, Missouri Currant, Oxeye Daisy, Broad-leaf Dock, Dogbane, Dogwood, Fleabane, Cinque Foil, Germander, Goldenrod, Grass-leafed Goldenrod, Huckleberry, Wild Indigo, Poison Ivy, June Berry, Red Maple, Mullein, Peach, Pear, Ragweed, Sour Gum, St. John's Wortel, Milky Sumac, Timothy, Vibernum, Wild Cherry, Yarrow.

In the adult stage they very rarely even suck juices, and never devour any part of a plant.

Preventives and Remedies.—As a preventive of the injurious ef-

fects of the Seventeen-year Locust, it is best to know their territory and date of occurrence, and in any locality where they are to appear during any summer, avoid planting young trees the year before. The injurious effects of this insect are remarkably noticeable from the fact that its injuries cause the twigs to break, and the leaves turn brown during midsummer, when the branches with such withered leaves hang on the trees and become very conspicuous, and cause the injury to appear really worse than it is. If the trees have been injured, it is best to prune them out in the parts that have been attacked, shaping the tree the best that is possible, but getting rid of the damaged wood. Before the occurrence of the Locusts it is best to anticipate their coming, and leave trees untrimmed during that year, so as to scatter their attacks over different branches, and later prune them, cutting out as many of the injured ones as may be possible, leaving the good branches to form the tops. Covering with netting to protect them can be practiced where there are a few choice trees to be saved, and young trees that are likely to be injured by having their trunks pierced in the process of egg-laying by the insects, may be wrapped around the trunks with some tarred paper or protecting cloth or wood veneer. It is best in planting young orchards to avoid planting during a year or two previous to the date of an outbreak of the seventeen-year locust, at least in a vicinity where trees, orchards, forests, woodlands or bushes are present in which these pests may be feeding on the roots. Ask the older inhabitants about the last date when the "Locusts" came, and count forward seventeen years from that date to ascertain the next date of their appearance.

The stories of our Seventeen-year Cicadas attacking men and beasts are entirely erroneous, and there is no cause whatever to fear these insects, as far as injury to mankind is concerned. Their only injury to vegetation is by piercing or sawing into the branches at the time of laying the eggs, but this may be very severe in young orchards planted near infested woodlands.

Several distinct broods have been traced, catalogued, and named in the United States, and as these are entirely distinct, but the species of insects is the same, they may cause the outward appearance of the Seventeen-year Cicadas at irregular intervals. However, the individuals in any one of these broods are not related to those in another, and they should not be confused. The broods occurring in Pennsylvania are as follows:

Brood VIII appeared in 1889 and 1906, and will also appear in 1923. This was very abundant in the eastern part of the Allegheny Mountain region of this State, and was also found throughout some of the counties further Eastward, such as Berks, Lehigh and Schuylkill. It appeared only in spots. For example, in Centre County there were two acres of a few square miles each in which it was

very abundant, but in other places it was not to be seen in great numbers.

Brood XI occurred in this State last in 1894 and will next appear in 1911, especially along the eastern and southern portions.

Brood XV occurred in 1897 in the western part of Pennsylvania, and will again occur in 1914.

Brood XVIII appeared in 1898 in the northwestern portion, as well as the northern portion of Pennsylvania. and will again occur in 1915.

Brood XX appeared in 1900 in the northwestern and western parts of Pennsylvania, and will again occur in 1917.

Brood XXII appeared in 1902 in Pennsylvania, especially throughout the southern counties, where it did much damage, particularly in Franklin and Adams counties, and will again occur in 1919.

Enemies: The Cicada, being a large and conspicuous insect, has a large number of natural enemies. There is no doubt that skunks, moles, chipmunks, pigs and ground inhabiting insects feed upon the nymphs or young while they are yet in the soil and sucking juices from the roots of trees. The most important period, however, for them to be attacked by their natural enemies is just after they appear above the ground and while their bodies are yet soft and full, and the wings too delicate and flimsy for use. At such times pigs, poultry, birds of nearly all kinds,especially the English Sparrow, and Serpents, Turtles, Chipmunks and Squirrels feed extensively upon them. We have found the stomach of the Copperhead Snake filled with scores of these insects. These pests have afforded at least eight per cent. of the food of the Copperheads which we have dissected, and no less than six specimens, out of forty-one of this reptile, containing food, were found to have fed upon Seventeen-year Cicadas. (See page 188 and Plate XXXVII, of Vol. IV, of the Monthly Bulletin of the Division of Zoology, September, 1906.)

We have also found the Hog-nosed Adder, Spreading Adder or Blowing Viper feeding upon Cicadas. See Vol. IV, p. 184, of this Bulletin.)

This particular subject is discussed in greater length on pages 367 to 377 of Vol. III, Monthly Bulletin of Division of Zoology.

FAMILY II. Fulgoridæ. The Lantern-fly Family.

The common name "Lantern-fly" refers to some of the insects belonging to this Family, although not living in the United States, which are phosphorescent or glow as though provided with lanterns. These are not the Fire-flies or Lightning Bugs, and are not to be confused with them. The Fulgorids which are found in this State are not phosphorescent, and consequently can not be said to carry lanterns.

There are possibly ninety species of this Family to be found in this State, about twenty of which we have in our collection. One of these belongs to the Genus Scolops, and feeds upon the grasses, while another, known to grapegrowers as the Mildew Leaf-hopper, and to entomologists by the scientific name Ormenis septentrionalis, feeds mostly upon wild grape vines, but may also attack a great many cultivated plants. It may occur in local outbreaks in considerable numbers. On June 21, 1905, we saw this in great numbers in Harrisburg, feeding upon the following plants: Apple, Grape, Peach, Currant, Gooseberry, Rose, Boxwood, Southern Tulip tree, Lily of the Valley, Violet, Deutzia, Wiegelia, Ampelopsis or Ivy, Gallingsoga or South American Weed, and other plants. In this particular case it appeared to be most destructive to the Boxwood, but as it was in the immature stage, and consequently without wings and not flying, and found abundantly upon each of the plants named, there is no doubt whatever of its feeding upon all of them.

Remedies.—Where this pest becomes abundant, it can be killed by spraying with about eight per cent. Kerosene Emulsion, or one pound of Whale Oil Soap in six gallons of water, or common soap, one pound in three gallons of water. When it reaches the winged state and flies readily, it is a good plan to spray with one of the above insecticides, made at dilute strength just mentioned, to avoid injuring the foliage, and as soon as the insects fly to the ground spray them again on the ground with an insecticide made two or three times as strong. Also, trap them with tarred cloth, the same as Leaf-hoppers, discussed in this Bulletin.

FAMILY III. Cercopidæ. The Spittle Insects or Frog Hoppers.

As one walks along the edges of woods or through pasture fields during the summer months, he often sees what looks like large drops of froth clinging to the leaves or stems of plants, and looking as though some animal, like a cow, frothing at the mouth, had passed that way and dropped the liquid upon the plant. This mass of buddles, which may be as large as a man's thumb, contains a small light-colored insect, which can be found by spreading it upon a leaf. Sometimes four or five insects may be found in the same mass of foam. Prof. Comstock says: "The froth is supposed to consist of sap, which the insect has pumped from the plant, by means of its beak, and passed through its alimentary canal. It is asserted that these insects undergo all their transformations within this mass; that when one is about to molt for the last time, a clear space is formed about its body; the superficial part of the foam dries, so as to form a vaulted roof to a closed chamber, within which the change of the skin is made. The adult insects wander about on herbage and trees. They have the

power of leaping well. The name 'Frog-hopper' has doubtless grown out of the fact that formerly the froth was called 'frog-spittle,' and was supposed to have been voided by tree-frogs from their mouths. The name is not, however, inappropriate, for the broad and depressed form of our more common species is something like that of a frog." These are to be seen upon the stems and leaves of various kinds of plants with but apparently little regard for the species which furnishes them nourishment.

Remedies.—Fortunately, they rarely become sufficiently abundant to demand treatment, but if they should occur in outbreaks, it is an easy matter to brush off the masses of froth, and spray with a contact insecticide, such as recommended for plant lice or Aphids.

FAMILY IV. Jassidæ. The Leaf-hoppers.

These insects are small in size, but the are often exceedingly abundant in numbers and quite destructive. They are elongate, generally at least three times as long as wide, and are distinguished from those of the next family by their smaller, lower and narrower bodies. They run quickly when young, and hop or jump readily, and fly in zigzag lines as soon as they become adult or winged. They live mostly on the under sides of leaves, generally causing them to assume a grayish appearance when infested.

The remedies for the Leaf-hoppers are contact insecticides, such as Kerosene Emulsion, Soap Solution, or very strong Tobacco Decoction, or Decoction of Pyrethrum or Hellebore. Apply the spray in such a way as to reach the under sides of the leaves. The nymphs or young insects are light in color, and although they run quickly, they do not fly away, and as they are soft-bodied and delicate, they are easily killed by spraying with proper contact insecticides. It is important to spray thoroughly and early. The mature insects fly so readily they often escape the spray liquid as it comes toward them, and even when they get a little of it on their wings, they fly down to the ground and rub off the liquid and return to the plants later. Even though the young should be killed by the spray at such times, the older ones may return to re-infest the plants by laying other eggs. It is best to spray the ground and adjoining plants when the winged insects fly from the plants that are being treated. Especially if they alight upon the ground, it is advisable to apply the spray liquid stronger there, either by having another vessel of stronger solution at hand, or by using the Kerosene Mixture, applied with a Kero-water Sprayer, so arranged that the percentage of Kerosene can be instantly changed by shifting the gauge. For vineyards we would recommend spraying the vines with about eight per cent. Kerosene Mixture, and after the adult insects light upon the ground, go through the row again at once, spraying with

at least fifteen per cent. Kerosene Mixture. Make the increase in strength by shifting the indicator that regulates the amount of Kerosene.

The Grape-vine Leaf-hopper (Erythroneura vitis) is one of the best known pests and one of the most serious enemies of the grape. It is not difficult to hold this in check, however, if the vineyardist will practice a diligent, intelligent use of the spray pump. This insect is too often known as "Thrips" by grape growers, but this is not a "Thrip," as this name belongs to the insects of the Family Thrypidae, Order Physopoda, to be discussed in a subsequent Bulletin.

The Rose Leaf-hopper (Typhlocyba rosæ) is quite familiar to growers of roses, as a little light-colored insect, found infesting the under sides of rose leaves, and causing them to appear spotted with gray on the upper side. As soon as the rose leaves turn gray, it may be suspected that this pest is injuring the same by piercing the leaves from the under side, and they should be sprayed or dipped well into one of the solutions named above. If a spray pump is not at hand, dipping will serve the purpose, or the application can be made very successfully by dipping a whisk broom into the solution and dashing it on the under side of the leaves by striking it against a stick or the hand. The little white specks seen adhering to the under sides of grape leaves are the cast skins of these insects, which are left behind after molting or advancing in the stages of their growth.

As the insects of this Family jump and fly readily, advantage can be taken of this feature of their habits by carrying a screen of cloth or paper covering, coated with Tar or Kerosene, along the leeward side of the plants, and have a person on the windward side to drive them against this oiled screen or tarred board. This principle can be utilized on an extensive scale in a large vineyard by arranging two screens, to be carried on a narrow cart between the rows of the vineyard, and drawn by a horse. The screens should be extended from each side of the cart upward and downward, like a roof on a house, or rather like the roofs of two houses standing side by side, with the cart between them. Let them come down over the vines, and especially be sure that the tarred screen reaches down well over the outside of each row, so as to come near the ground. The horse walking between the rows will help to frighten the pests, making them jump toward the outside against the screen there. If this be not sufficient, brushes can be attached to the harness in such a way as to help drive the Hoppers out against the outer side of the screen.

As the Leaf-hoppers pass the winter in the adult stage, hibernating in leaves, brush, rubbish and loose earth, it is important that all leaves and rubbish be gathered and burned late in the fall after

the pests have gone into their winter quarters, and if possible rake over the loose earth occasionally during the winter to expose the insects to the rigors that would destroy them.

FAMILY V. Membracidæ. The Tree-hoppers.

While the Leaf-hoppers are all small and narrow, the Tree-hoppers, or those belonging to the Family Membracidæ, are larger, sometimes being one-half inch in length, are much taller, and generally have points, spines or knobs somewhere on their bodies. From their large eyes and grotesque appearance, these are truly called the "brownies" of the insect world. They jump and fly readily, and also live by piercing and sucking vegetation. One species, of rather common occurrence, is called the Buffalo Tree-hopper (Ceresa bubalus) from the fact that at the sides of the thorax there are projecting horns, more or less reminding one of the appearance of a Buffalo. This insect is a uniform green color, and is sometimes a pest to apple trees. In depositing its eggs in small crescent-like slits, arranged in rows in the bark, it inflicts some mechanical injury to the twigs. These twigs, showing the egg-punctures of the Leaf-hopper, are sometimes sent to us with the supposition that they contain the San José Scale. Where sufficiently abundant, it is well to spray with contact insecticides, and if the twigs be much injured by egg-punctures cut them out in the fall.

There are two other families of insects, commonly known as Leaf Hoppers, one of these being known by the scientific name Bythoscopidae, and the other as the Tettigonidae. The differences are of a character too technical to admit of discussion in a popular bulletin, but all species belonging to the three families of "Leaf Hoppers" agree in feeding upon vegetation by puncturing the under sides of the leaves and sucking the juices, causing them to become dry and brittle, and most of them pass the winter as adult or mature insects in grass or rubbish, and lay eggs in the spring, from which there comes an early summer generation, which in turn lays eggs to produce a second brood before fall. Wherever they become sufficiently abundant as to demand treatment, these remedies are practically the same, without regard to species, as those mentioned above.

FAMILY VI. Psyllidæ. The Jumping Plant Lice.

These insects are very small, looking like plant lice, and flying readily. From this they are given the common name of "Jumping Plant Lice." They suck the juices from plants, as do other Hemiptera, and may be very destructive during summer seasons, when they appear in great numbers. Some of the Psyllids have the habit of making galls, one of which forms galls on leaves of the

hackberry or Celtis. Plate XII, Fig. 2, shows these Psyllids, which we bred from the Hackberry Leaf Gall, magnified twenty times.

The Pear-tree Psylla (Psylla pyricola) is by all means the most serious pest of this Family represented in this State. It is at times and in some places very destructive to the pear crop of this and adjoining States, and should be watched with great care by pear growers. It sucks the sap from the leaves and twigs, and also from the stems of the fruit. It is often to be found around the petiole of stems of the leaf and also that of the fruit. It passes the winter in the adult stage around the trees, and especially under the edges of loose bark on the trunks, and should be treated by spraying at least once during the winter time with a contact insecticide. It should be sprayed again in the spring after the leaves expand, using Soap Solution or Kerosene Emulsion, and again in midsummer if any of the pests yet be present. A prominent grower of pears in New York reported to us that he had lost many of his pear crops, amounting to thousands of bushels, by this pest, and in the fall, as it was present in great numbers on the trunks of the trees, it appeared that it would pass the winter there and destroy his crop again the next year. However, the White-breasted Nuthatches came to the orchard in numbers, and he encouraged them to remain by fastening pieces of fat meat in his trees, and protected them from molestation. The Nuthatches remained, and fed on the pests all winter, and cleaned up the trees so effectively that he could scarcely find any in the spring. Measures against this pest would be, (1) Protect the insectivorous birds, especially Nuthatches, Chickadees and Warblers; (2) Clean up fallen leaves and burn them late in fall; (3) Spray the trunks and branches of trees with Lime-sulphur or some other contact insecticide (oils or soap) during the winter time; (4) Repeat the spraying of infested trees during the early part of June; (5) Repeat the spraying operation at any time during the summer, when the pests appear in numbers.

There is a species of winged Psocid or Book Louse that looks to the unaided eye very much like the Psylla, but is larger, has longer wings and in structure does not agree with it. In our efforts to locate the Pear-tree Psylla we have obtained from contributors several specimens of this Psocid, which have appeared in such numbers as to cause considerable alarm by their outbreak in the latter part of the summer, but they are really not injurious and need not cause fear.

FAMILY VII. Aphididæ. The Plant Lice or Aphids.

The Plant Lice, or Aphids, "Green Lice," etc., are among the most common of our insect pests. They are likely to attack almost any kind of vegetation, and by sucking the juices they may make de-

formed leaves and cause considerable injury. Of course, they also are sucking insects, the same as are the other members of this Sub-order and Order, and for this fundamental reason poisonous insecticides cannot be used against them. They must be killed with contact applications, if at all.

The Plant Lice are all very small insects, being green, white, brown or red in color. The white ones live in the soil on the roots of plants, and we mostly see the various species of the green kinds. The brown ones are generally found upon the leaves of the peach, plum and cherry. The life history of Plant Lice is one of the most peculiar and marvelous in all Nature. There may be a score or more generations or broods of this insect in one year, or but one which may be produced by bearing living young. They mostly reproduce agamically or by a process known as Parthenogenisis, which means reproduction without mating.

The Plant Lice often change food plants during the year, sometimes passing from one plant to another of an entirely different character. For example, the Hop Louse or Aphis, so destructive to the hop fields of the West, spends part of its time as an enemy of the leaves of the plum. The full peculiar life history of one species of Aphis or Plant Louse is illustrated in that of the Apple Aphis (Aphis mali), which we have worked out originally some years ago. This insect passes the winter in the form of very minute black shiny eggs on the branches of apple trees. In the early spring, about the time the buds are bursting and the green leaves are peeping forth, these eggs hatch and the very young and delicate Plant Lice crawl to the forthcoming green leaves and commence to suck the sap from them and grow. At this time they are so delicate that they are easily killed by a sudden fall of temperature, or even by a cool rain. In only a few days they grow to full size and commence to bear living young at the rate of several per day for many days. The adults or mature insects are wingless and also regarded as sexless. Their young are also wingless, and without mating commence to bear young in a few days, and continue this method of reproduction for generation after generation, until the leaves are thick or tough at midsummer, when a winged generation develops, and flies to the roots of grasses, and there commences to bear young, which feed upon the roots of the grasses from summer until fall, reproducing generation after generation by the agamic process. About the time the fall apples are ripening, the Aphids on the grass roots develop wings and fly to the leaves of the apple tree, where they bring forth one more generation or brood, which this time mates and lays eggs on the twigs of the apple trees. These eggs remain there exposed during the winter and hatch early the next spring, and thus the peculiar life cycle, with its alteration of host or food plant, is completed.

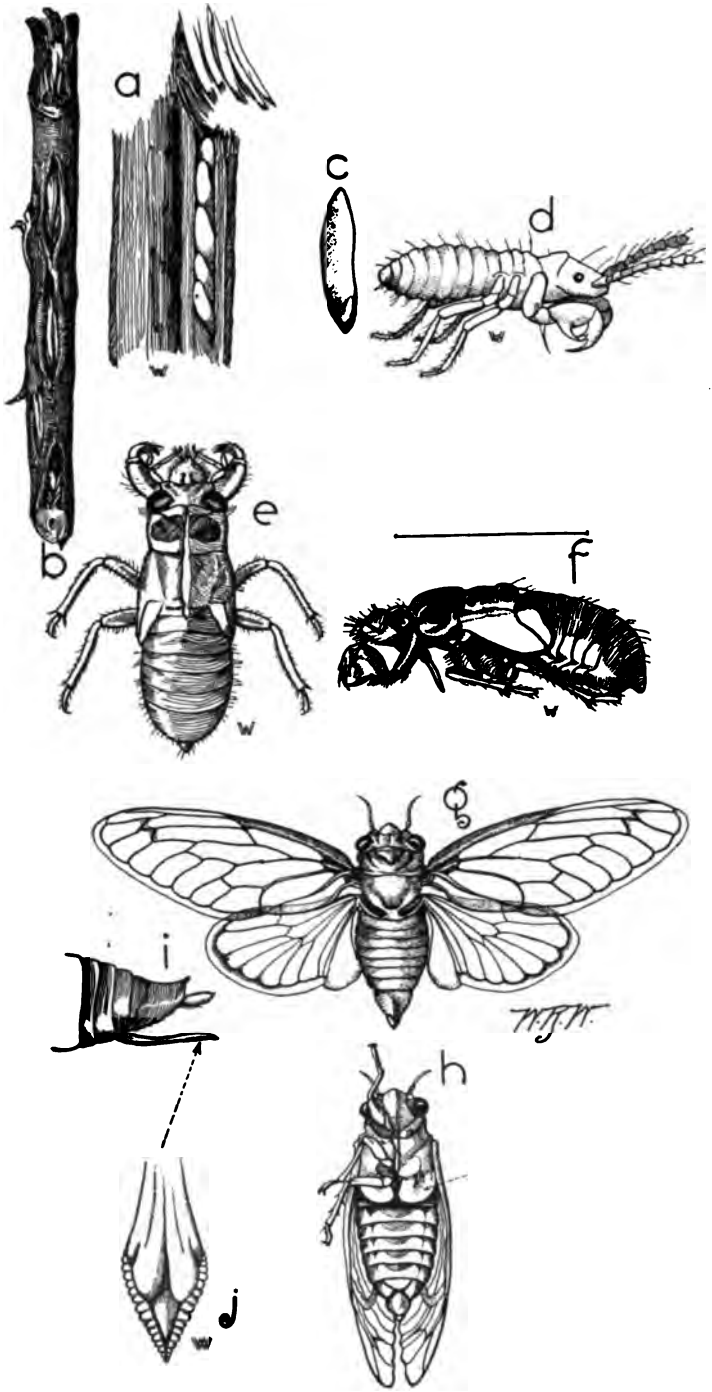
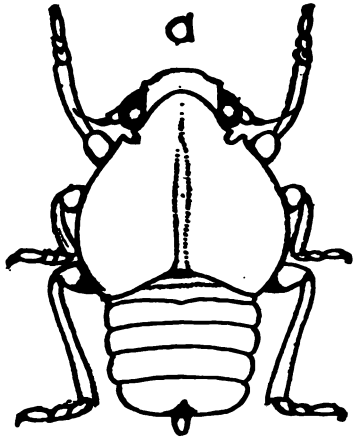
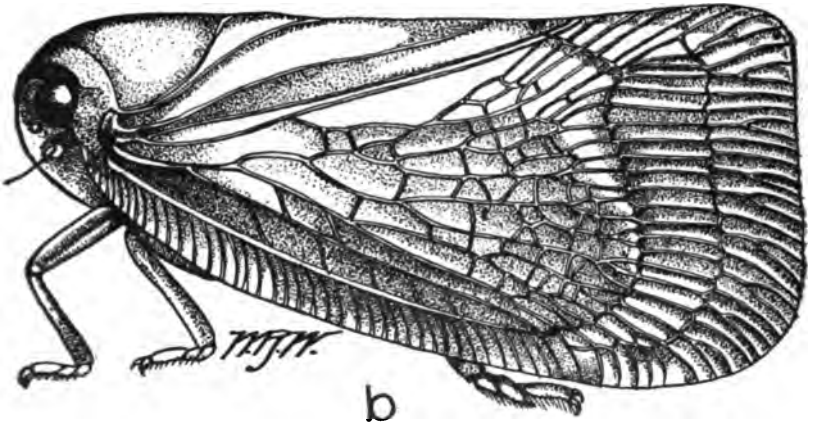


PLATE VI. 17-year Cicada or "Locust" (*Tibicen septendecim Linn*). a, Eggs in wood, magnified; b, egg-punctures in twig, natural size; c, egg, enlarged 9 diameters; d, young cicada just hatched, enlarged 16 diameters; e, young cicada, dorsal view; f, left side, natural size indicated by hair line above; g, dorsal or top view of winged or adult Cicada; h, ventral or under view of the same, natural size; i, ovipostor or egg-laying organ, natural size; j, tip of ovipostor, greatly enlarged. Drawn by W. R. Walton, in office of H. A. Surface, Economic Zoologist.





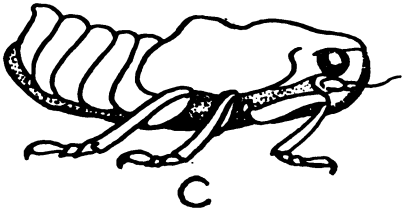


PLATE VII. Mildew Leaf Hopper (*Ormenis septentrionalis Spin*). **a and c, young or nymph, greatly enlarged; b, adult or mature leaf hopper, greatly enlarged.** Standing over outline nearly natural size. Drawn by W. R. Walton, **in office of H. A. Surface, Economic Zoologist**

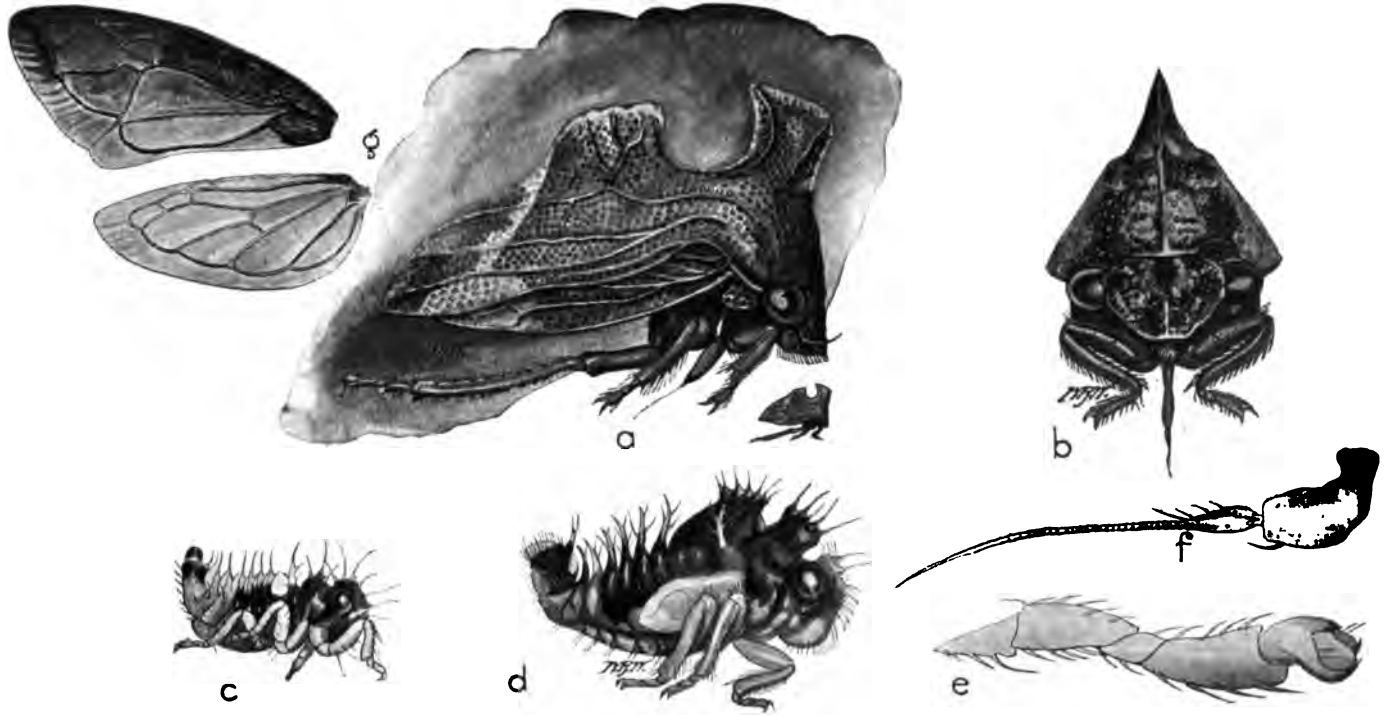


PLATE VIII. Thistle Tree Hopper. (*Entäta sinuata Fabr.*) a, mature or adult insect, lateral view, greatly enlarged, standing over outline of same species, natural size; b, adult or mature insect, front view, greatly enlarged; c, very young nymph; d, older nymph; e, leg and foot of same; f, antennae of same; g, left pair of wings of same. Drawn by W. R. Walton in office of H. A. Surface, Economic Zoologist.

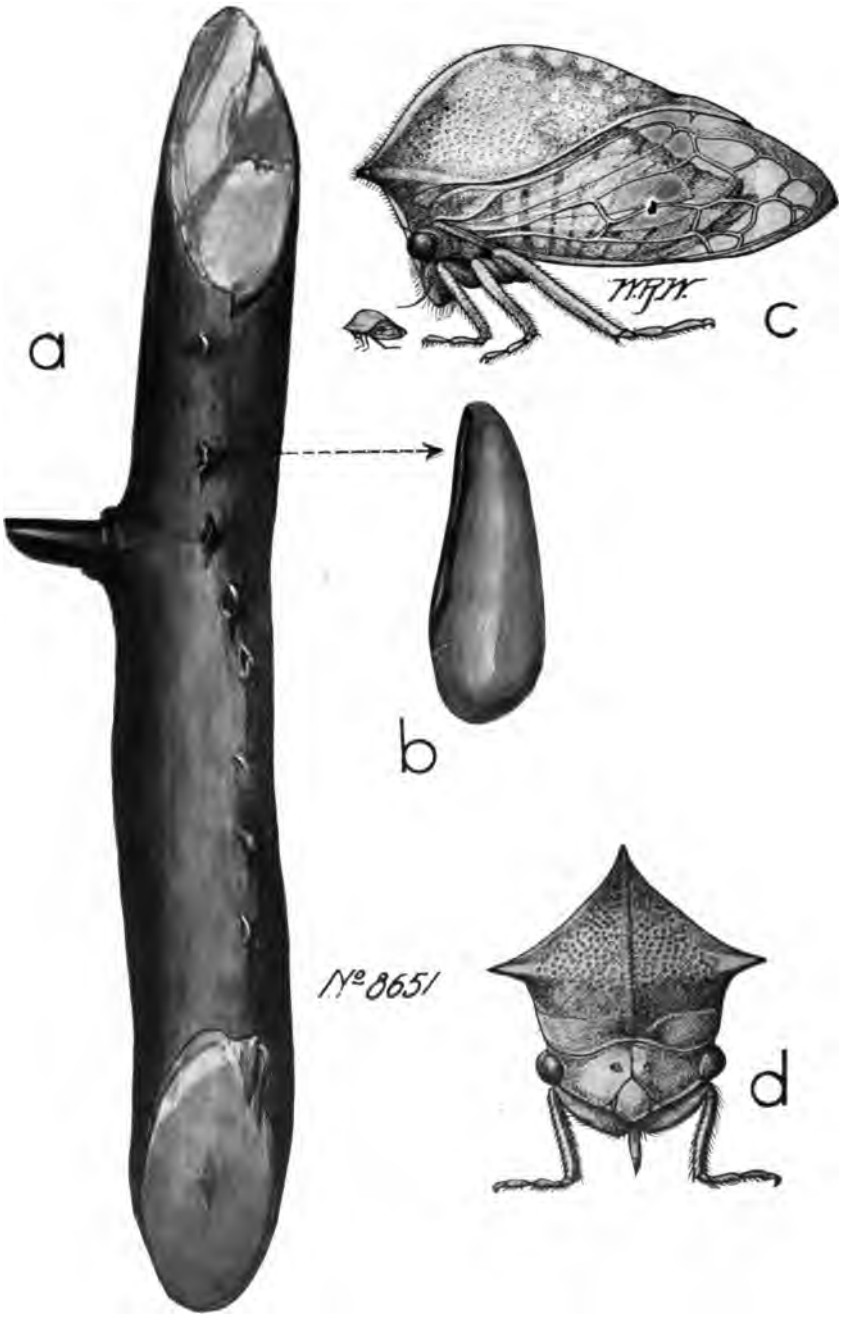


PLATE IX. Buffalo Leaf Hopper. *(Ceresa bubalus Fabr.)* **a, twig showing egg punctures in bark, enlarged 2 diameters; b, egg of same, greatly enlarged; c, left side of insect, greatly enlarged, standing over outline figure, natural size; d, front view of same, greatly enlarged. Drawn by W. R. Walton, in office of H. A. Surface, Economic Zoologist.**

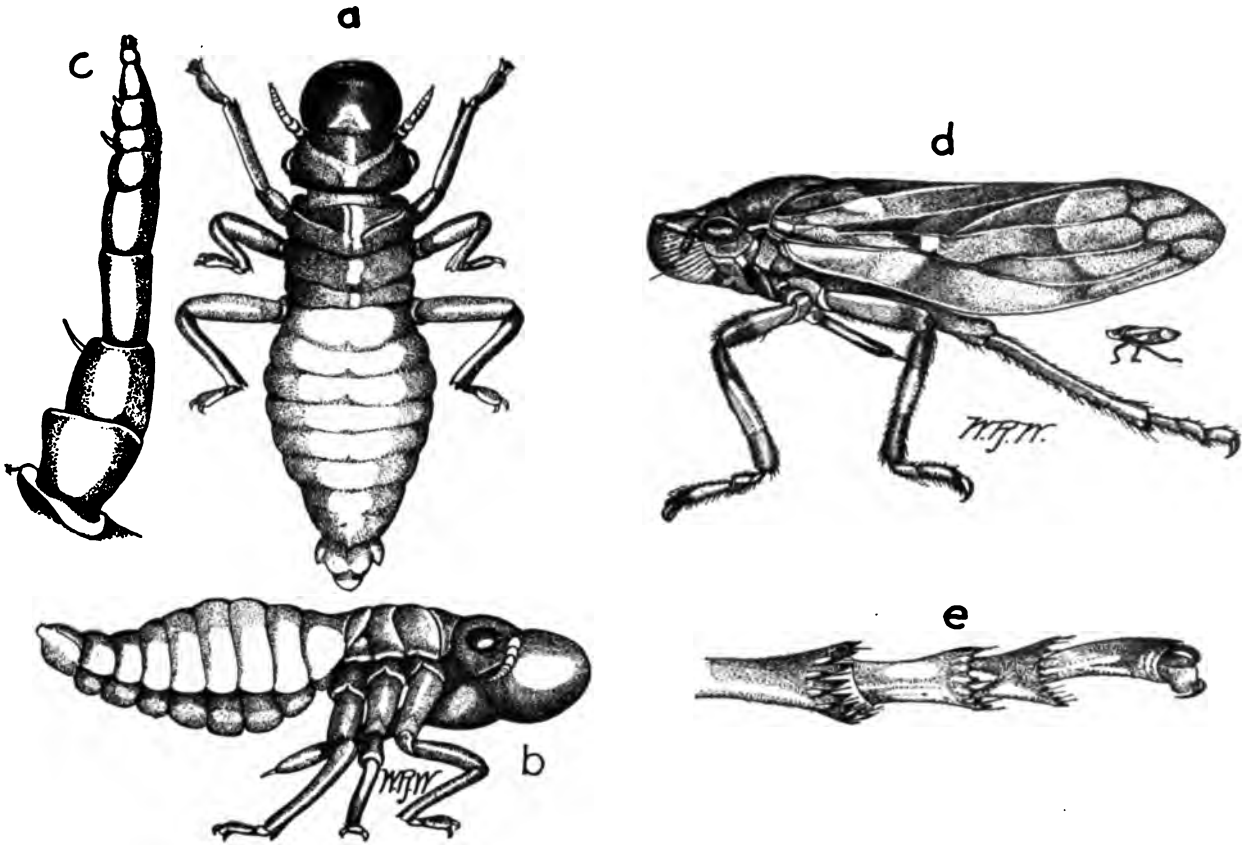


PLATE X. Spittle Insect or Frog Hopper (*Aphrophora parallella Say.*) a, nymph of same, dorsal view, greatly enlarged; b, nymph or young of same, right side, greatly enlarged; c, antenna of same, very greatly enlarged; d, adult or winged form of same, much enlarged and standing over outline figure which is natural size; e, leg of same, greatly enlarged. Drawn by W. R. Walton, in office of H. A. Surface, Economic Zoologist.

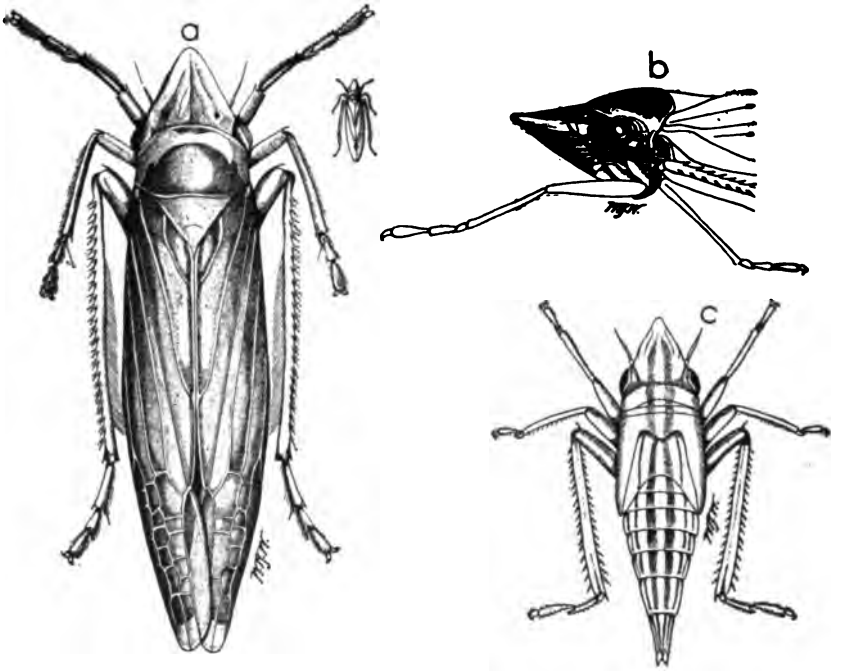


PLATE XI. Grass Leaf Hopper (*Diedrocephala mollipes Say.*) a, adult or mature insect, greatly enlarged, beside an outline drawing showing natural size; b, head of same, greatly enlarged; c, nymph or young of same, greatly enlarged. Drawn by W. R. Walton in office of H. A. Surface, Economic Zoologist.

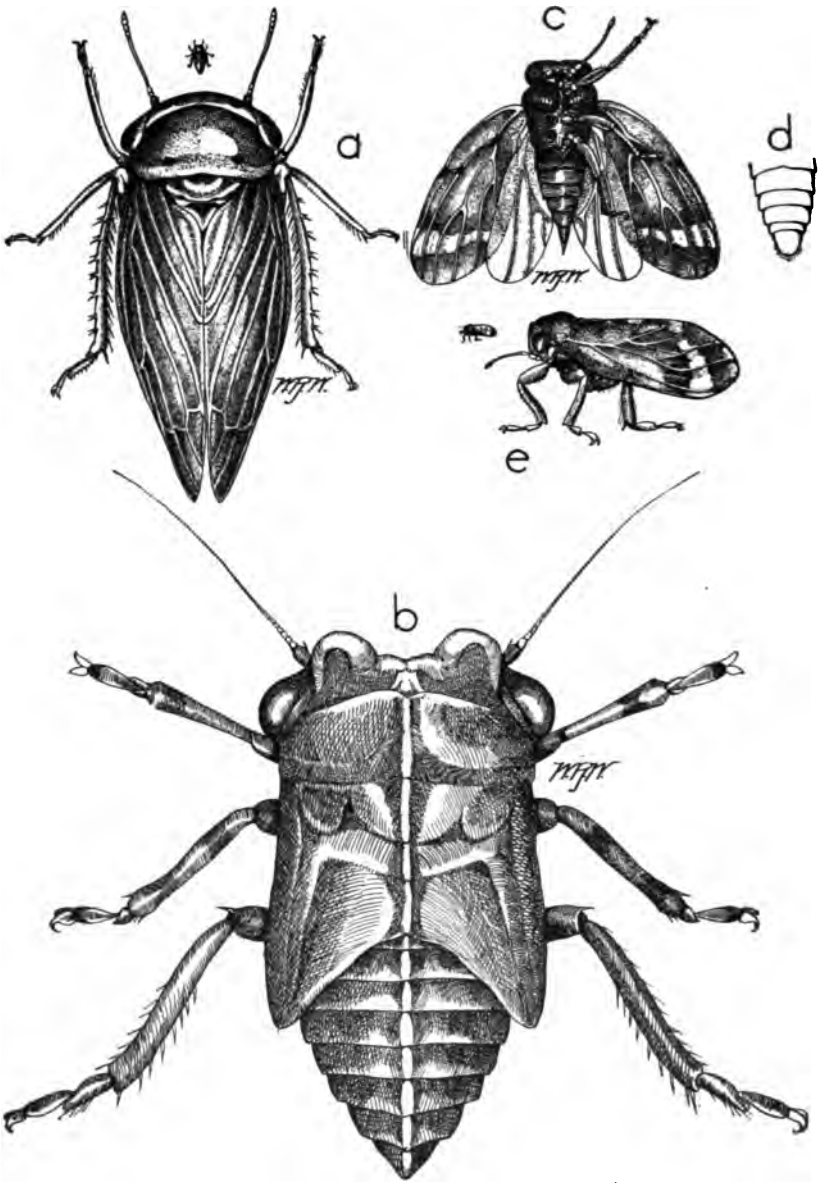


PLATE XII. a and b, 4-Spotted Leaf Hopper *Agallia 4-punctata Prov.* a, adult or mature insect, greatly enlarged, with outline of same, natural size, above; b, nymph or young of same, much more enlarged; c, d, and e, Hackberry Psylla (Psylla sp.) c, adult or mature female insect, showing under side, greatly enlarged; d, tip of abdomen of male, greatly enlarged; e, left side of same, with outline drawing, natural size standing in front. Drawn by W. R. Walton in office of H. A. Surface, Economic Zoologist.

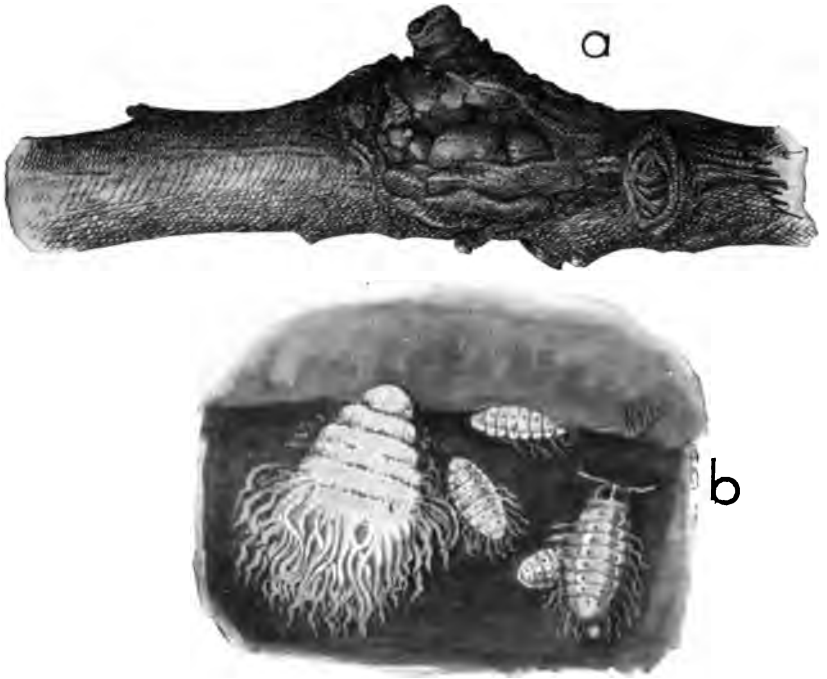


PLATE XIII. Woolly Aphis (*Schizoneura lanigera Hausm.*) a, branch injured by same, natural size, showing spot where this pest chose to work; b, young and old of woolly aphis, greatly enlarged. Drawn by W. R. Walton in office of H. A. Surface, Economic Zoologist.

During the spring while they are on the apple tree they are found almost wholly on the under sides of the leaves or at ends of the tender young shoots. Their injuries often cause the leaves to twist out of shape or become badly curled and form pockets or enclosures, which protect them from rain and sun and from some of their natural enemies, such as the birds.

On the trunks of trees that are thus infested, a great many ants can be seen going up and down in lines, and persons often think that the ants are injuring the trees. This is not true, however, for these little insects are going to the Plant Lice to feed on the sweet, clear liquid, which the Aphis secretes, as such insects as Ants, Flies, Bees and Wasps readily partake of this secretion. This liquid is called honey dew, and often drops upon leaves or bushes beneath the trees in such a way and in such a quantity as to make them look as though they are varnished. When Bees are unable to obtain nectar or bet ter food, they sometimes store honey dew in great quantity, but this is not good honey, and should not be sold as such, neither should it be relied upon as winter stores for a colony of Bees.

A black fungus often develops in the honey dew if it remain upon the leaves or twigs, and the spores of this fungus often cover it to such an extent as to make it look as though coated with soot. This gives a diseased appearance to the tree, and we are sometimes asked what should be done for such disease. Of course, it is not infecting the tree or plant, but is due to the presence of the honey dew upon which it drops, and of course, to the Aphids which produce the liquid. There is no need to give a remedy for the Black Smut, which may cover the leaves in patches like soot, but the remedy should be for plant lice which produce it.

Remedies.—As the Aphids multiply very rapidly and become numerous, their enemies likewise increase in numbers in their communities. In such places can be seen both the adults and larvæ of Lady Beetles, feeding freely upon them, as well as the larvæ of the Lace-wing (See Plate V, B), and the blind but very efficient larvæ of the Syrphus Flies. This last-named larva can be seen striking blindly in various directions for Plant Lice, and when it blindly strikes one, it holds it in the air, and by a pumping or sucking action, which can be seen plainly, sucks the juices from the body and throws it away, again striking blindly in every direction for a new victim. The Lady Beetles and their larvæ devour the Plant Lice, while the larva of the Lace-wing sticks its strong hollow jaws into them and through the cavities of these jaws suck their juices, and throws the bodies away; while the larva of the Syrphus Fly holds them in the air and pierces and sucks them as described.

Among other enemies of the Plant Lice are the birds, especially the Warblers, Wrens and Titmice in the spring time, Kinglets and

Warblers in the fall of the year, and the Chickadees during the winter time. This spring a gentleman from Mechanicsburg reported to us that a pair of yellow birds were feeding on something around his peach tree, and our inspection showed that these were the Summer Yellow Birds or Warblers, and that they were feeding abundantly upon the Peach Aphids, which had seriously injured and deformed the leaves of his peach trees. Last fall we saw the Kinglets and Warblers in the late fall feeding abundantly upon the fall brood of Apple Aphids, which had developed upon the leaves of the apple trees and were then laying their eggs. The Chickadee and Tufted Titmouse are known to be great enemies of the eggs of Aphids, which they are seeking as they swing around on the twigs, like little acrobats, during the winter time.

No insects multiply so rapidly as the Plant Lice, and none are more effectively held in check by their many enemies. Among the smaller insect enemies or internal parasites is the Braconid or a very small wasp-like insect, which feeds in the interior of the Aphid and bores its way out by making a hole in the back, over which it lifts a lid like a trap door. The dead and perforated Plant Louse is often seen.

Immense numbers of Aphids are destroyed by the fungous disease, which attacks them, and which causes them to swell like little balloons, turn brown and die, and remain for some time upon the leaves where they live. When Plant Lice commence to become abundant on the leaves, those that have been killed by this disease are generally conspicuous by their larger size and dark brown color. The leaves that are badly infested by this pest, and twisted out of shape or turning brown should be examined with care before attempting to spray them, and it may often occur, especially if the pests have been present for some days that they will be found dead or attacked by such a multitude of enemies which can be found among them, that it will be useless to spray for them, because the natural forces hold them in check. While there are no insects that multiply more rapidly than Plant Lice of different species, there are at the same time none which have a greater number of natural enemies which curve their outbreak.

The Corn Plant Louse (Aphis maidis) is one of the most common pests on corn roots in this State, and as it is attended and protected by Ants, we have the common inquiry as to what should be done for Ants on corn roots. As a matter of fact it is not the Ants that are the direct enemies of the corn, although they are responsible for the damage done by taking care of the Plant Lice, which are the real depredators. In the spring of the year, shortly after the corn appears above the ground, the Ants dig little tunnels at the roots of the corn plants, and then find the Plant Lice or their

eggs, and carry them to these burrows, and place them on the corn roots where they keep them and care for them, and in return obtain the sweet juice or honey dew secreted by the Aphis. The latter-named pest does considerable injury where it is abundant, and it has become so dependent upon the Ants that without them it would be unable to reach the corn roots and inflict this damage. There is no remedy after the plants are once attacked, but the proper method is to follow crop rotation, not planting corn the second year successively in a field where corn was previously attacked by the Corn Plant Louse; using fertilizer in the soil, which is for the purpose of invigorating the plants and helping them to overcome the effects of their attacks; plowing the ground in the late fall, and harrowing to break up the nests of the Ants, where the Aphis eggs are stored and cared for by the Ants during the winter time; keeping down the weeds by early spring cultivation, especially smart weed, pigeon weed, and grass on which these pests also feed; with a disk harrow, stirring in the late spring and also in the winter, when possible, the soil that is to be planted in corn the next spring.

There is a Gray Aphis found throughout the State of Pennsylvania on the leaves of Maple trees along streets in cities and villages. They especially attack the Norway Maple. During the months of May, June and July this Aphis multiplies in great numbers and causes the green leaves to fall abundantly. The fallen leaves, as well as those remaining on the trees, and the sidewalks themselves, are often covered with honey dew until they are shiny and look as though varnished. The presence of these pests often causes considerable alarm, and although they are very numerous during June and July, they disappear rather suddenly, as they seem to reach the end of their career on shade trees when the leaves become thick and tough and fully mature, about midsummer. We have observed many trees attacked by this pest, and although it can be killed by spraying with contact applications, such as are recommended elsewhere, we doubt if it is necessary to take the trouble of attempting practical remedies for it. The treatment we advise is to water infested trees, loosen the soil about their roots, use fertilizer or mulch to feed and invigorate them, and apply more water.

Most Plant Lice upon the foliage of plants are green, and consequently called "Green Aphids" or "Green Plant Lice." Among these are these species infesting the Apple, Rose, Cabbage and many other plants. The Green Aphids are delicate and easily destroyed by contact applications, made so dilute and mild that the plants which they infest will not be injured. The application, whenever they are present in such numbers as to justify it, will hold them in check. Sometimes this need not be oftener than once per month. It is not

are, of course, called "White Flies" from the color, but are so small as to be ignored or not observed by many persons. They occasionally, but rarely, attack plants, especially tomatoes, to a destructive extent outdoors; but in greenhouses, especially in the southeastern corner of this State, they have effected considerable damage to herbaceous plants of various kinds. Since they are also suctorial, they are not to be destroyed by internal poisons or arsenites, and can only be held in check by abundant spraying with contact insecticides, such as mentioned above, or by fumigation.

The most effective material for fumigating for these and other greenhouse pests is Hydrocyanic Acid Gas, generated by dropping Cyanide of Potassium into a solution of Sulfuric Acid and water, and leaving the room tightly closed for at least one-half hour. This gas is quite deadly, and should not be used by one who does not understand the method or has not previously read carefully what has been published here or elsewhere on this subject. As we have published in detail upon the methods of fumigation (See Vol. III, p. 110, Monthly Bulletin, Division of Zoology) with this important but deadly gas, and can send a printed description of the methods to each one applying for the same, we do not feel it advisable to take the space to re-publish upon this subject here.

(To be continued.)

THE GRAIN MOTH.

In many portions of the State of Pennsylvania there is a small moth found abundantly, which in the larval stage, feeds in grains of wheat from the time the crop is ripe until fall. Especially where wheat is hauled into the mow and kept in the straw, unthreshed, it is liable to be attacked to such an extent that many of the grains are excavated and left very light and almost worthless. The insect doing this damage is the Angoumois Grain Moth, so called from the province of Angoumois, France, where it was first noticed doing extensive damage. It is now quite destructive throughout the southeastern quarter of this State, and as there is only one practical measure that can easily and safely be taken for it, we publish at this time to call the attention of farmers to the importance of threshing their wheat just as soon as possible after harvest and putting the grain into bins or store houses or selling it. If it is to be put into a bin to be kept for a long time, it can safely and easily be fumigated with Carbon Bisulfid, using one pound of this liquid for

each one hundred bushels of the grain. Pour the liquid over the top of the grain, in a tight bin, box or other vessel, and then cover it with wet blankets to keep the fumes from escaping. Keep fire away from it, as it is as explosive as gasolene.

However, it will not be necessary to go to the trouble and expense of fumigating if the grain is threshed early and put into storage. We have a record of one definite case where the farmer threshed half of the wheat crop in the field and the other half was hauled to the barn and kept in the mow until the early part of the winter before threshing. That which was threshed first was sold as first class wheat, because it was not injured by the larvæ feeding inside the grains, but the half that was kept in the sheaf and threshed later was almost entirely ruined by the pests.

The great point in this article is to advise wheat growers to thresh early, and either dispose of the crop or store it in tight bins. Do not permit wheat to remain in the straw, either in stacks or in the mow. If this advice be acted upon it will result in saving hundreds of thousands of dollars worth of wheat in this State. Infested grain is light in weight and little better than bran for either feeding or milling purposes. Thresh early and avoid loss.

THE ROSE BUG.

One insect that has appeared in great numbers throughout this State this year, and of which we have received many inquiries, is a small yellowish brown beetle commonly known as the Rose Bug or Cherry Bug. It is a serious pest in devouring leaves, flowers and fruit, eating irregular holes in the surface of the leaves, and even eating young grapes from the vines. It is so familiar to growers of grapes, cherries, roses and some other plants that it needs no description, and this article is for the purpose of giving a general answer to the many inquiries we have received concerning it.

There are but few practical remedies to be recommended. Arsenical poisons have not given satisfactory results when applied for this pest, for the reason that internal poisons are so slow in action that in many cases the pest is not killed until the damage is done, and also others appear on the infested trees from time to time as rapidly as those which have been poisoned die and disappear, and consequently it looks as though poisons have had but little effect indeed.

Contact applications are likewise unsatisfactory, because the beetle, having a hard shell, is not easily penetrated by oils or soap solutions, and consequently these are remedies that would give only partial relief and would not prove wholly satisfactory.

The most reliable remedy is to pick the pests from the plants they infest, and drop them into a vessel of water upon which a little Kerosene Oil is floating, or shake them into pans containing water and oil, or shake them over cloths held beneath the infested plants or spread upon the ground, and which have been soaked with Kerosene or covered with Tar. Blankets soaked with Kerosene, stretched or spread beneath infested trees or shrubs, give a most excellent means of fighting this pest, because the Rose Bugs will be killed by falling upon the saturated blanket, even though they should not be entirely covered by the oil. It is thus not necessary to go to the trouble of gathering every one by hand after they fall upon the saturated blanket. It would be sufficient to stretch sheets under the infested plants and shake the insects on them, rolling them together and dropping them into oil. Kill such pests while they are few in numbers to prevent their increase during another year. All shaking or jarring for such pests should be done either very early in the morning or late in the afternoon when the air is too cold for them to fly freely and they will drop when disturbed. The early part of the forenoon is best for this. If they do not fall by shaking they should be brushed off with sticks or picked by hand. At the present time nothing better for Rose Bugs is known than hand picking as here directed.

We have seen rose bushes effectively protected by covering with thin netting like mosquito netting during the period when these beetles are most destructive. Another plan is to plant as traps some kind of tree or bush the leaves of which are especially attractive to the Rose Bug. Such an one is the sassafras. These insects feed mostly upon the sassafras leaves, and if a few small trees of this kind be planted in or near the lawn, garden or orchard the Rose Bugs will be attracted to them and it will not be a difficult matter to shake the pests from such trees once or twice per day and thus preserve others that cannot be so easily attended. It is to be noted that the leaves and twigs of the sassafras are particularly smooth, and it is much more difficult for the Rose Bugs to cling to them than to the leaves of such a plant as the Rose. It is hoped that this article will give answer to the many inquiries we have received this summer upon the subject.

FLEA BEETLES.

There are a great many kinds of small dark or brown jumping insects, with hard shells or coverings, inhabitating plants which grow low or near the ground, and which jump freely when approached

and leave their marks in the form of small brownish specks, eaten in the epidermis or covering of the leaves where they have been feeding. These insects are known as Flea Beetles from the fact that they jump like fleas, but they are true Beetles or "Case-winged Insects." They are not fleas by any means, and are not capable of attacking a human being or animal of any kind. Their chief injury is inflicted upon the leaves of plants by eating small holes partly through them until they may appear brown. Potatoes and beans are especially injured by insects of this kind, which subject was discussed on pages 353 and 354 of Vol. IV of this Bulletin. We there recommended driving these pests, with the wind, against boards or cloths covered with Tar, thus trapping them in great numbers, and also spraying with the Bordeaux Mixture and Paris Green added. The Bordeaux Mixture is a repellant, as the insects greatly dislike to feed upon any plants covered with it. The Paris Green aids by poisoning and also killing Potato Beetles and other insects that are present. Growers can not afford to let potatoes remain unsprayed when it is so easy and cheap to apply such material as Bordeaux Mixture and Paris Green, not only for these pests but also to prevent Blight and Rot and destroy other insects injuring the leaves.

The formula recommended for potato spraying is as follows:

Quick Lime, 6 pounds.
Copper Sulfate or Bluestone, 4 pounds.
Paris Green, one-third pound or 4 ounces.
Water, 50 gallons.

Spray liberally with this, and repeat it as often as is necessary if the material be washed away by hard rain, or at the longest once every ten days to two weeks. It will not only destroy such pests as Potato Beetles and Flea Beetles, but will also prevent Potato Blight and Rotting. Continue the application until after the vines are fully mature and ready to ripen.

On page 353 of Vol. IV of this Bulletin it was shown conclusively that our experiments with the Soda Bordeaux and Paris Green for the Flea Beetle were quite successful in giving good results, which were worthy of further trial by practical growers of such plants.

SPRAYING.

"Spraying" is a term too carelessly used and too generally applied by most persons. It merely refers to the process or method by

which a liquid material is thrown in very fine particles. This material may be either a fungicide, used to prevent the appearance of plant diseases, or an insecticide, used as a remedy for insects. The term "dust spray" is also coming into use, but this properly should be "dusting." Spraying can properly be defined as putting a liquid into the form of a spray or a very fine mist. For this purpose the operator uses a force pump to furnish the power, and a nozzle so constructed as to break the stream of liquid into a spray as it leaves the pump or hose. The liquid may contain materials to act as germicides, fungicides or insecticides. Among the last-named are the oils, soaps, caustic materials, decoctions, powders in suspension, and poisons, either in solution or held in suspension by the liquid. The method of spraying is practically always the same, and consists merely in covering with a thin uniform coating the tree, plant or other object to be sprayed. The time or date of spraying is of very great importance, and success or failure may be dependent upon the right or wrong time, and even though all other elements may be favorable. For plant diseases or fungi the spraying should be with some substance like Bordeaux Mixture, which destroys the fungus germs before they enter the plants, and should be applied before the plants show evidence of disease.

Nearly all applications for insects are made when the pests are actually present rather than before they come, and are more effective when applied when such pests are very young or when they are feeding most voraciously. Contact insecticides are designed to kill insects by merely touching them and not by being eaten by them. Among these are the oils and oil emulsions of various kinds, decoctions, such as tobacco juice; powders, such as hellebore, pyrethrum, buhac, etc., applied either dry or in liquids; soap solutions and caustic preparations such as the lime-sulfur wash. These are used for sucking insects, such as scale insects, plant lice, squash bugs and others that pierce and suck the plants but do not eat the tissue.

The internal poisons are used for chewing or biting insects, which eat the part of the plant where the material is to be applied. Only chewing insects can be killed by such poisons, which are generally some compounds of arsenic and are therefore called "arsenites." Among the chewing insects to be killed by internal poisons are grasshoppers, roaches, caterpillars, and beetles, or the so-called "hard-shelled bugs" of all kinds. In fact, if any insects eat away the surface of any part of the plant its attack is such that it can be killed by arsenical poisons, but otherwise such materials are not to be used for it.

Persons whose plants are infested should learn the nature of the pests and apply the proper remedies at the right time. The person who speaks of using the Bordeaux Mixture for any insects or Paris

Green for plant lice or scale pests indicates his entire lack of knowledge of the elements of combating plant pests, and can not hope to have success until he makes at least a slight study of this subject of growing importance.

COMMERCIAL SPRAYERS.

We are often asked the names and addresses of persons who will do commercial spraying, and have, therefore, made an effort to obtain these. The list given below is by no means complete, and has been obtained from various sources, which we regard as authentic, although we have not corresponded with the individuals given, and their names and addresses are here published without their knowledge, but with a view toward helping them as well as the community in which they live.

It may be that some person desires to have his potatoes sprayed for blight and rot, or his fruit sprayed for ripe rot, or plums or peaches sprayed for curculio, or apples, pears and quinces sprayed for the second brood of the codling moth, or the June spraying for the San José Scale or plant lice, or such other spraying as can and should be done during the summer months. Sometimes pests may appear almost suddenly, and the prime factor in their treatment is to apply remedies immediately. It is thus important to know where the owners of property that is being destroyed can obtain the help they need. For this reason we feel justified in publishing this list, and in inviting correspondents to give us other names and addresses of persons who are doing commercial spraying. Any one desiring to take up this business, which is recommended as one of the growing and needed enterprises of this State, will receive free assistance from this office.

Bedford County.

Mr. Todder, Bedford, Pa.
Mr. L. O. Walter, New Enterprise, Pa.

Berks County.

Mr. W. P. Ruth, Sinking Springs, Pa.
Mr. J. S. A. Schaeffer, North Heidelberg, Pa.
Mr. J. H. Giles, 123 S. Fifth Street, Reading, Pa.
Mr. W. K. Hummelreich, Blandon, Pa.

The Board of Poor Directors of Shillington have a Niagara outfit which they will rent.

Blair County.

Mr. N. A. Rhodes, Tyrone, Pa.

Bucks County.

Mr. H. L. Shelly, Quakertown, Pa.

Chester County.

Mr. Dennis Gallagher, Strafford, Pa.
Mr. J. D. Thomas, Whitford, Pa.

Clinton County.

Mr. H. S. Bollinger, Lock Haven, Pa.

Cumberland County.

Mr. John Hale, New Cumberland, Pa.

Dauphin County.

Mr. J. R. Snavely, Harrisburg, Pa.
Mr. E. B. Mitchell, Harrisburg, Pa.

Lancaster County.

Mr. Jacob Chambers, Lancaster, Pa., care Dr. S. T. Davis.
Mr. G. W. Bellman, Lancaster, Pa.
Mr. A. F. Trout, Quarryville, Pa.
Mr. C. D. Herr, Cresswell, Pa
Mr. G. B. O. Felty, Millersville, Pa.
Mr. B. F. Barr, Lancaster, Pa.
Mr. J. Wilmuth, 735 E. Orange Street, Lancaster, Pa.
Mr. Menno E. Shirk, Stevens, Pa.
Mr. Moses Lapp, Gap, Pa., R. F. D. No. 2,
Mr. Harlan Gatchell, Peters Creek, Pa., R. F. D.

Monroe County.

Mr. Randall Bisbing, E. Stroudsburg, Pa.

Montgomery County.

Mr. D. M. Ellis, Bridgeport, Pa.
Mr. H. E. Wohlert, Bala, Pa.
Mr. John M. Markley, Lansdale, Pa., Lock Box 245.

Mr. D. Simpson, 48 E. Oak Street, Norristown, Pa.
Mr. G. L. Oddy, Centre Square, Pa.
Mr. Wm. Sturzwecher, Lansdale, Pa.
Mr. Peter Reilly, Rosemont, Pa.

Northampton County.

Mr. J. N. Hartzell, E. Bangor, Pa., R. F. D. No. 43.

Philadelphia County.

Mr. Herbert Inman, 2419 N. College Avenue, Philadelphia, Pa.

Snyder County.

Mr. W. H. Bingaman, Beavertown, Pa.
Mr. J. J. Tobias, Beavertown, Pa.

Union County.

Mr. H. A. Taylor, Mifflinburg, Pa.
Mr. Geo. Kunkel, Lewisburg, Pa., R. F. D. No. 1.

York County.

Mr. John Gardner, E. King Street, York, Pa.

ROBINS DESTROY WIREWORMS.

Difference Between Observation and Interpretation.

It frequently happens that certain facts are observed definitely and consequently can not and should not be denied, but the interpretation is such that might lead to quite erroneous conclusions, and even evil results. One of the most important duties of the teacher of Nature Study or any branch of Natural History is to give training not only of the minute observation of facts, conditions and phenomena, but also their own interpretation and practical application.

An important case illustrating the difference between interpretation and observation is seen in that of a truck grower near Harrisburg, who recently observed Robins at work in his cabbage field, apparently pulling the cabbage plants in numbers, and he at once shot quite a number of the birds. When brought to trial by the Game Commissioner, he acknowledged having shot the birds because they were destroying his property in pulling the cabbage plants, and

testified that he had seen them take the plants in their bills, pull them up and throw them aside. He was not certain that they ate any part of the plant nor anything near the plant, and it might have been thought that they were doing it only for mischief. Doubting such an unusual occurrence as Robins pulling plants for the purpose of destroying them or without some definite and doubtless beneficial end in view, a representative of the office of the Economic Zoologist went with the Game Commissioner to the truck field where the cabbage was growing, and there they saw, indeed, Robins in considerable numbers hopping over the ground, and often stopping to pick up objects, and even scratching in the ground with their bills, and then eating something. They were particularly busy quite near the cabbage plants, and a number of plants were seen lying on the ground beside the hills, wilted and dying. A careful examination revealed the fact that the plants had been cut off rather than pulled out, and in at least one case the Robin was seen to throw aside one of these plants, which had been cut off but was yet standing in its hole in the ground. Around the foot of the plants and just beneath the surface of the soil worms were to be found by the hundreds. It was found that the wireworms had cut the cabbage plants, and the Robins were busily engaged destroying these very injurious pests for which there is practically no remedy, after they appear, and of which there are far too few enemies. The facts were that the truck grower observed the Robins at work around his cabbage plants, and perhaps occasionally lifting out some that had been cut off by wireworms, and he jumped to the conclusion that the Robins were pulling his plants, and proceeded to shoot his most beneficial friends. The correct interpretation was that the plants were cut off by pests for which there is no practical remedy at this time of year, and the Robins were feeding extensively on those pests, but as some of the plants remained in the ground where the wireworms were to be found, although cut off and dying, the birds found them in their way and threw them aside. It is doubtful if the killing of the birds was justified under such circumstances, even with the positive and conscientious belief that they were doing damage. It was the duty of the truck grower to ascertain the facts of the case and act intelligently upon them, fully as much as it was his duty or privilege to protect his crops.

Details of the above case are published for the sake of emphasizing the importance of correctly interpretating what is to be observed in Nature, and acting most intelligently and properly. It is generally wrong interpretation of observed facts which leads to the common popular errors concerning Natural History subjects rather than mere fabrication of false belief. For example, the popular erroneous idea that there is a Horn Snake with a poisonous sting in its tail

appears to be founded upon the observed fact that the House Snake or Milk Snake has a tail that is rather hard and pointed, and from the observation of this, the story of the Horn Snake appears to have grown. It is to be hoped that readers will join in aiding the work of the Economic Zoologist to ascertain and publish the truth in Nature.

SPRAYING POTATOES FOR BLIGHT AND ROT.

Dear Sir: In your Zoological bulletin I find the receipt for late blight on potatoes to be the Bordeaux Mixture. Can too much mixture be applied to the vines, if applied with an ordinary sprinkling can, or must it be applied only in a spray?

Thanking you for an early reply, I am,

Respectfully,

H. J. H.

Mr. H. J. Haldeman, R. F. D. No. 2, Jonestown, Pa.:

Dear Sir: Replying to your favor of the 15th making inquiry concerning the use of the Bordeaux Mixture, applied with a sprinkling can for late blight of Potatoes, I beg to say that I do not think that a man can possibly obtain good results by attempting to apply spray liquids with a sprinkling can. He might as well attempt to shave with a hoe, as to spray with an ordinary sprinkling can. There is just as much difference between shaving and hoeing as there is between spraying and sprinkling. The spray is for the purpose of throwing a liquid containing fungicide or insecticide into extremely fine particles, as fine as mist, in such a way that the leaves or fruit will be covered by a uniform film of this, as though with fine water dew, which should not run together, and should not stand in drops nor drop off the leaves. When applied in this way it will have no disastrous effects of burning the foliage, and will at the same time protect the plant tissues or destroy the insects.

If applied as a sprinkling can spray or with an apparatus that does not give a spray, the material falls on the plant in drops and may either collect in drops on the leaves and burn holes through them by being too greatly concentrated on those spots, or it will drop off entirely and in so doing it will leave streaks on the leaves or fruit where no fungicide will remain, and consequently the purpose of spraying will be defeated by leaving the leaves or fruit untreated

THE MONTHLY BULLETIN OF THE DIVISION OF ZOOLOGY FOR AUGUST, 1907.

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OUR MONTHLY CHAT WITH READERS.

Do you want a Bulletin on "The Turtles and Lizards of Pennsylvania" as a companion to "The Serpent Bulletin," issued a year ago? If so, please send us specimens at once. They may be sent by express, at our expense; or by mail (when postage will be refunded), either alive or dead, although we should prefer them sent dead.

* * * No Names Dropped From Mailing List.—We occasionally receive letters asking why names have been dropped from the mailing list, as the inquirer is not receiving the Bulletins. We take this occasion to state that no names have been dropped from our mailing list since the revision of the same a year ago last spring, and none will be dropped until the mailing list again increases enough to reach beyond the legal limit. However, this will not be for some time, as the last Legislature made provision for increasing the number of our Bulletins that are actually demanded by the public to the extent of fifty thousand if needed. We are not having that many printed at the present time, but if the demand should come for them, it is possible for us to obtain them.

* * * Change of Address.—In notifying us of change of address, you should always put the old address down as well as the new. This is necessary in order to make the proper change.

* * * Back Numbers Available.—Of some of the previous issues of the Monthly Bulletin the supply is exhausted, and of others there are yet enough available to complete sets for those who may wish to preserve the entire volume for binding. Those who need back numbers should write at once, definitely asking for the numbers which they need, and they will be sent if in stock.

Naming Collections of Insects: We take this occasion to make the preliminary announcement that beginning in November of this year, we shall be able to name free of charge such collections of Pennsylvanian insects as collectors may wish to make and submit to us for identification. This will aid teachers, pupils, amateur collectors and others in naming and classifying their material and will give them opportunity to commence now, during the summer time, to make collections with a view of having them named some time during this fall or winter.

In making collections care should always be taken to collect and preserve duplicate specimens and attach to each a collection number, giving the date, locality, food plant, and any other interesting notes of observations that may be recorded concerning each species. When the collection is sent to us this collection number should be sent with its respective specimen and a duplicate specimen should be retained by the collector with the same number attached to it, in order to facilitate identification or naming by reference to the number on the specimen.

Please address all specimens, notes and inquiries to H. A. Surface, Economic Zoologist, Harrisburg, Pa.

NURSERY INSPECTION.

As the annual inspection of nurseries in Pennsylvania begins this month, it is appropriate to call the attention of the public to what the State is doing in this regard. Four men are at the present time devoting their efforts to inspecting the nurseries in the State of Pennsylvania. Wherever the San José Scale is found on nursery stock, or older trees on the nursery premises are infested, they are to be destroyed at once by the owner, who will be given a certain number of days in which to prepare for a second visit of the inspector. If no San José Scale be found on nursery stock or on trees on the nursery premises, a certificate, granting the right to sell from that nursery for one year, will be given at once without further requirements. However, if upon the second visit by the inspector, the San José Scale be yet found present in the nursery, the nurseryman will be given another time in which to rid the premises of pests by destroying all infested stock, trees, hedges, bushes, etc., and at the end of this second interval the inspector will make a third trip to the premises. The expense of this third visit and all necessary subsequent trips must be paid by the nurseryman, because of his failure to comply with the directions given during the first visit of the inspector and rid his premises of pests by destroying all infested trees and vines. The fumigating house must be ready to be tested by smoke by the inspector not later than his second visit.

Wherever San José Scale is found upon any premises if there be no fumigation house one must be erected immediately, and whether new or old, it must be thoroughly tested by the inspector, by smoke, to see if it be free from any leakage of gas whatever, and if any be found it must be made as tight as possible and will be tested again in order to determine its efficiency as a means of fumigation before a Certificate of Fumigation will be granted.

It is worth while indeed for the nurserymen to clean up their own premises and get their fumigating houses in proper condition to avoid the extra expense of otherwise additional and unnecessary visits of the inspectors.

Persons growing strawberry plants only are not to be regarded as nurserymen, and in the future their strawberry fields will not be inspected excepting in those cases where they wish to ship plants into other States and their shipping requirements demand that packages contain Certificates of Inspection. In such cases our State Inspector will visit the premises as soon as notified by the owners, and will make inspections and grant certificates when proper.

The following communication has been addressed to growers of strawberry plants:

The general practice of granting Certificates of Inspection to growers of strawberry plants who grow no other stock, will henceforth be discontinued.

In the future, inspections of strawberry plants will be made, and certificates issued only, in cases where this office has been notified of intended shipment to other States or countries, which, in order to be promptly accepted and forwarded, must be accompanied by a Certificate of Inspection according to the laws of the State for which it is destined.

Those who grow strawberry plants in connection with raspberry and blackberry plants, or other nursery stock, and who at present hold Certificate of Inspection will have their premises inspected as heretofore, without further notice.

Persons wishing to ship strawberry plants by freight or express, should notify this office and their premises will be promptly inspected at any time after August 1st of each year.

Please note that where strawberry plants are not to be shipped by railroad, they need not be accompanied with certificate of inspection, and growers are at liberty to sell such plants in Pennsylvania without any restrictions whatever.

H. A. SURFACE, Economic Zoologist.

E. B. ENGLE, Nursery Inspector.

It should be distinctly remembered that it is decidedly against the law to ship into this State any shrubs, trees, bushes or other plants without certificates of inspection being attached to the same, and all that are of varieties liable to attack by the San José Scale must also carry Certificate of Fumigation to show that they have been fumigated before being shipped. It is the duty of transportation companies to refuse to carry packages of nursery stock without copies of the proper certificates being attached to each, and to refuse to deliver such uncertified stock in this State. Dealers, or persons who are in the business of buying and selling trees, must not sell trees without a license from the Department of Agriculture, and to procure said license they must notify the Department, giving the full list of names and addresses of the firms which they wish to represent, whether they be in Pennsylvania or in other States. These nurseries will then be investigated, and if they be found to have certificates in their own respective States they will be permitted to send their stock into Pennsylvania without further requirement, (excepting the necessity of fumigation of all varieties liable to infesta-

tion by San José Scale), but if they be transacting business in such manner in their own State that they do not have certificates, their agents can not obtain licenses for operating in this Commonwealth.

To all tree dealers in this State the following circular letter has been addressed:

Dear sir: Enclosed find copy of Circular No. 4, containing blank for renewal of agents' and dealers' certificate. If you are now holding a certificate you will notice that it expires by limitation July 31, 1907 and that applications for renewal should be made before July 1, 1907. Kindly give this immediate attention and return application promptly, giving the names and addresses of all the nurseries from which you propose to procure your stock for the coming year.

If you are selling on salary or commission for one nursery only, said nursery holding a valid certificate of inspection, and also of fumigation for all stock liable to infestation by San José Scale shipped into Pennsylvania, you will not require a separate dealer's certificate, as the certificate of the nursery you represent will be sufficient.

Please read enclosed Circular No. 4 very carefully, and do not fail to give date, and signature of a witness, as provided for on blank application. Note especially, also, that a copy of Certificate of Inspection must be attached to each bale, box or package delivered, and if sent into Pennsylvania from any other State or Country, it must also have attached to each package the statement that it has been properly fumigated.

If representing one nursery only, on salary or commission, please report name of nursery to this office for record.

(Signed.)

N. B. CRITCHFIELD,
Secretary of Agriculture.
H. A. SURFACE,
Economic Zoologist.

To those tree dealers who have recently obtained new certificates the following circular letter has just been addressed:

Dear Sir: Enclosed find agents' and dealers' certificate for the year ending July 31, 1908. While the nursery or nurseries on your application, and from whom you propose to buy your stock for the coming year, are approved and have good and valid certificates of inspection, it is well to remind you that in this and many other states, all certificates expire, by limitation, at various dates from and after June 1, and that some nurseries which have certificates at this time may not have them renewed for the coming year.

Should we be advised later in the season that any nursery or nurseries named on your application have not succeeded in securing certificates, you will be duly notified from this office, and said nurseries will be stricken from the list and an opportunity given you to add the names of others instead.

Please remember that it is your privilege at any time, upon your notice to this office, to add to the list of nurseries from whom you expect to procure stock.

Special attention is called to the law requiring that nursery stock shipped into Pennsylvania from other states must not only be accompanied by a certificate of inspection, but must be fumigated before shipment. Copies of certificates of inspection and fumigation must be attached to each box, bale or package delivered, and every purchaser of a bill of trees, has a right to demand and be shown to his satisfaction that his trees have been inspected and fumigated, as required by law.

(Signed),

H. A. SURFACE,
Economic Zoologist.
E. B. ENGLE,
Nursery Inspector.

The following is a copy of our Circular No. 4:

To Agents and Dealers in Nursery Stock in the State of Pennsylvania:

In pursuance of authority vested in the Secretary of Agriculture by act of Assembly approved March 31, 1905, providing for the inspection of nurseries and infested premises, and the control of injurious insects and diseases; all tree agents and dealers doing nursery business within the State, except such as are properly accredited agents, canvassers, or salesmen for nurseries within or without the State holding valid certificates of inspection, will be required to file with this Department a statment or certificate, certifying that they will buy or receive for re-sale only such nursery stock as comes from sources approved by the Secretary of Agriculture or his duly authorized agents or representatives.

Agents or dealers who buy stock at wholesale, to be retailed from their own or any other premises, must do so under a dealers' certificate, which will be furnished free of charge by this Department under proper rules and restrictions.

As stated previously, agents or canvassers who represent properly certified nurseries, and that deliver stock only as packed by the firm they represent, can do so without certificate other than that held by the firm for which they are acting.

Applications for certificates must be made before July 1 of each year (or as soon thereafter as possible), so that proper time may be had for necessary investigations, and all applicants must state

where they expect or intend to get their stock. A copy of certificate must be attached to all packages delivered.

No stock can be legally sold in this State that is found to be infested with San José Scale, Black Knot, Yellows, Wooly Aphis or Crown Gall.

For certificates and further information address the Secretary of Agriculture or Economic Zoologist.

(Signed),

N. B. CRITCHFIELD, Secretary of Agriculture.

H. A. SURFACE, Economic Zoologist.

The tree dealer then fills the blanks in the following statement and files it in this office, when his certificate is sent to him.

Statement of Agent or Dealer.

To be Filed with the Secretary of Agriculture.

In consideration of the receipt of Certificate No. ..... for the year ending July 31, 19 , I hereby agree that I will purchase nursery stock for re-sale from the following firms only; such firms holding valid official certificates approved by the proper authorities.

LIST OF NURSERYMEN OR GROWERS.

.....	.....
.....	.....
.....	.....
.....	.....

(Permission is given to add to this list at any time by consent of the Secretary of Agriculture.)

I further agree that I will receive no nursery stock which is not accompanied by a Certificate of Inspection, and when shipped from without the State, which has not been fumigated; and further, that I will not sell or give away any stock whatever that has not been inspected.

....., Agent.

Witness, ...	P. O., ...
P. O., ...	County, ...
Date, ...	State, ...

The following persons have been granted new certificates as tree dealers in Pennsylvania for the year extending from July 31, 1907 to July 31, 1908, although, under the distinction made above, some may be agents rather than dealers:

ALLEGHENY COUNTY.

H. M. Devereaux, Swissvale, Pa.
W. B. Bockstose, Castle Shannon, Pa.
L. F. Miller, 1023 Garret St., Pittsburg, Pa.
E. C. Hauser, Bellevue, Pa.
Charles Honess, Allegheny, Pa.
J. F. Zimmerman, Emsworth, Pa.

BEAVER COUNTY.

J. C. Withrow, Vanport, Pa.
J. H. Gutermuth, Rochester, Pa.
A. E. Crouch, Rochester, Pa.

BERKS COUNTY.

Jacob H. Weand, Reading, Pa.
M. E. Smeltzer, Reading, Pa.
Alfred Dreibelbis, Reading, Pa.
L. M. Neischwender, Hamburg, Pa.

BLAIR COUNTY.

James Hopkins, Juniata, Pa.

BRADFORD COUNTY.

J. F. Gable, Athens, Pa.
Jos. E. Hamilton, R. D. No. 16, Rome, Pa.
J. P. Sibley, R. D. No. 16, Rome, Pa.

BUCKS COUNTY.

A. P. Kratz, Silver Dale, Pa.

BUTLER COUNTY.

Geo. W. Haine, R. D. No. 32. Callery, Pa.

CARBON COUNTY.

Paul Neihoff, Lehighton, Pa.
David N. Rehr, Lehighton, Pa.
L. B. Wagner, Weissport, Pa.

CHESTER COUNTY.

John Alcorn, Malvern, Pa.
F. W. Richardson, Paoli, Pa.

CLEARFIELD COUNTY.

Thos. W. Munro, DuBois, Pa.

CLINTON COUNTY.

W. W. Richie, Lock Haven, Pa.

CRAWFORD COUNTY.

J. C. Boyd, Guy's Mills, Pa.
F. M. Fleming, Cochranton, Pa.

CUMBERLAND COUNTY.

Ira E. Bigler, Camp Hill, Pa.
D. C. Rupp, Shiremanstown, Pa.
Towzer & Wolff, Carlisle, Pa.

DAUPHIN COUNTY.

Geo. F. Greenawalt, Hummelstown, Pa.
T. A. Woods, Harrisburg, Pa.
J. R. Snavely, Harrisburg, Pa.

DELAWARE COUNTY.

John Wetherill, Chester, Pa.

ERIE COUNTY.

W. S. Waldo, North East, Pa.
C. E. Powell, Lundy's Lane, Pa.
W. C. Batcheler, Erie, Pa.

LACKAWANNA COUNTY.

Giles L. Clark, Scranton, Pa.
A. J. Noble, Scranton, Pa.

LANCASTER COUNTY.

J. S. Holwager, Elizabethtown, Pa.

LEBANON COUNTY.

Samuel P. Moyer, Myerstown, Pa.

LEHIGH COUNTY.

N. C. Beachy, Allentown, Pa.

LUZERNE COUNTY.

H. M. Rogers, Dallas, Pa.

McKEAN COUNTY.

F. S. Palmer, Bradford, Pa.

MONROE COUNTY.

L. D. Eilenberger, E. Stroudsburg, Pa.

MONTGOMERY COUNTY.

A. E. Wohlert, Merion, Pa.

NORTHAMPTON COUNTY.

T. S. Headman, Seidersville, Pa.
Dominico Sebastino, Roseto, Pa.

NORTHUMBERLAND COUNTY.

H. F. Frank, Montandon, Pa.
Jos. Harris & Bro., Shamokin, Pa.

PHILADELPHIA COUNTY.

J. R. Giffen, 1826 No. Willington Street, Philadelphia, Pa.
Wm. Henry Maule, Philadelphia, Pa.
Walter P. Stokes, Philadelphia, Pa.
Henry F. Michel Co., Philadelphia, Pa.
Hosea Waterer, Philadelphia, Pa.
Johnson Seed Co., Philadelphia, Pa.

SCHUYLKILL COUNTY.

Walter J. Keller, Pottsville, Pa.
W. O. Snyder, Minersville, Pa.
D. H. Smith, Haas, Pa.

TIOGA COUNTY.

Arthur Edwards, Elkland, Pa.

UNION COUNTY.

J. G. Oberdorf, Mifflinburg, Pa.

YORK COUNTY.

C. H. Snyder, York, Pa.
J. H. Painter, York, Pa.

OHIO.

Jones & Vernon, Troy, Miama county, Ohio.

The following Tree Dealers held Certificates for the year ending July 31, 1907, but have not yet renewed their applications for the coming year:

ADAMS COUNTY.

R. E. Alden, Aspers, Pa.

BLAIR COUNTY.

Isaac N. Kemp, East Freedom, Pa.

CRAWFORD COUNTY.

A. B. Greenfield & Son, Conneautville, Pa.
G. G. Fish, Conneautville, Pa.

DAUPHIN COUNTY.

A. H. Shreiner, Harrisburg, Pa.
Gilbert Troutman, Millersburg, Pa.
J. M. Christman, Fort Hunter, Pa.

ERIE COUNTY.

E. E. Carr, North East, Pa.

LEHIGH COUNTY.

Thomas P. Roth, Orefield, Pa.

LUZERNE COUNTY.

W. H. Langyan, Hazleton, Pa.

MONTGOMERY COUNTY.

John Reig, Jenkintown, Pa.
L. H. Kline, Pennsburg, Pa.

NORTHUMBERLAND COUNTY.

C. H. Weaver, Watsontown, Pa.

SCHUYLKILL COUNTY.

Samuel Buehler, Schuylkill Haven, Pa.

WESTMORELAND COUNTY.

Joseph Thomas, Greensburg, Pa.

Such careful methods as those outlined above must result in greatly reducing the San José Scale that may be sent upon nursery stock, and no excuse exists for any dealer in trees, or nurseryman, to send infested stock to any customer in this Commonwealth. The purchaser has a right to demand to see both the Certificates of Inspection and Fumigation, and we can give the public assurance that we have planted many fumigated trees and find their growth to be as good and strong as those trees that are not fumigated. We do

not believe that fumigation, when trees are dormant, injures them in the least.

The man who is merely acting as a tree agent or representing only one firm, taking orders on either commission or salary, and not buying trees to sell in the capacity of a dealer, will be permitted to act or transact his business under the certificate of the firm which he represents, and thus is not required to obtain a special license from this Department.

The following is a full list of the nurserymen which are licensed to sell nursery stock in the State of Pennsylvania at the present time:

Adams County.

Name.	Place.	Acres
R. M. Elden,	Aspers,	3
C. A. Stoner,	Gettysburg,	3
Cornelius Bender,	Idaville,	1
E. W. Yengst, R. D. No. 1,	Idaville,	½
H. W. Sowers,	Latimore,	1½
Charles J. Wilson,	Mummasburg,	3
W. E. Grove,	York Springs,	10
H. R. Plank,	York Springs,	3

Allegheny County.

J. B. Murdoch & Co.,	Pittsburg,	2
Elliot Nursery Co.,	Springdale,	33
G. R. Elliot,	Westview,	1
Mark E. Head,	Bellevue,	½
John W. Jorden,	Millvale,	½

Beaver County.

Mackall Bros.,	Beaver,	20
*James Smith,	Beaver Falls,	6
A. P. Goodwin,	Industry,	12
*J. Hoyt,	Industry,	15
*Henry Finley,	Industry,	4
*A. J. Freed,	Homewood,	10
*W. A. Freed,	Homewood,	5
*Joseph and Charles Engle, R. D. No. 2,	Beaver,	12
*Arnold Bros., R. D. No. 2,	Beaver Falls,	9

Bedford County.

Austin Wright,	Alum Bank,	2

Berks County.

Wenrich Bros.,	Robesonia,	½

Butler County.

Pierce Bros.,	Butler,	10

*Grow berry or small fruit plants only.

Blair County.

Name.	Place.	Acres
F. A. Bowser,	Newry,	¼

Bucks County.

J. L. Lovett,	Emilie,	10
Somerton Nurseries, 125 S. 5th St., Phila., A. U. Bannard, Mgr.,	Somerton,	20
Henry Palmer,	Langhorne,	4
Horace Janney,	Newton,	5
D. Landerth Seed Co.,	Bristol,	5
The W. H. Moon Co.,	Morrisville,	200
S. C. Moon Co.,	Morrisville,	50
J. G. Youngken,	Richlandtown,	1
S. R. Trach, R. D. No. 1,	Springtown,	1

Chester County.

George Achelis,	West Chester,	200
The Conard & Jones Co.,	West Grove,	30
The Dingee & Conard Co.,	West Grove,	30
Rakestraw & Pyle,	Kennett Square,	200
J. A. Roberts,	Malvern,	16
Hoopes Bro. & Thomas,	West Chester,	600
J. B. Reif,	Spring City,	2
Benj. Connell,	West Grove,	4
E. B. Keating,	Kennett Square,	1½

Clearfield County.

W. S. Wright,	Clearfield,	½

Crawford County.

*Anderson Bailey, R. D. No. 66,	Cochranton,	12
*Henry Roberts, R. D. No. 66,	Cochranton,	4
*J. T. Reed, R. D. No. 66,	Cochranton,	2
*Park Bailey,	Cochranton,	3
*Samuel J. Cooper,	Cochranton,	4
*Lewis Swogger, R. D. No. 33,	Carlton,	2
C. L. Unger, R. D. No. 11,	Meadville,	3
Prudential Orchard Co.,	Shermansville,	25
*J. Q. Marsh,	Geneva,	2
*L. L. Wood,	Geneva,	2
*Peter Schaffner, R. D. No. 2,	Meadville,	1½
*James T. Irwin,	Cochranton,	1½
*Samuel Bailey, R. D. No. 66,	Cochranton,	1
Atkin & Hall, R. D. No. 41,	Linesville,	2½

*Grow berry or small fruit plants only.

Dauphin County.

Name.	Place.	Acres.
C. P. Scholl, R. D. No. 1,	Halifax,	6
Snavely & Trombine,	Progress,	3
J. M. Christman,	Fort Hunter,	½
Andrew Coble, R. D. No. 1,	Middletown,	2½

Delaware County.

P. Z. Supplee,	Collingdale,	25
J. J. Styer,	Concordville,	2
M. F. Hannum,	Concordville,	1
W. E. Caum (Lessee),	Haverford,	4
John G. Gardner,	Villa Nova,	5
Wayne Iron Works,	St. Davids,	5
H. H. Baitles,	Newtown Square,	
Joseph H. Brinton,	Camp Ground,	½

Erie County.

*A. F. Youngs,	North East,	4
*Orton Bros.,	North East,	5
L. G. Youngs,	North East,	20
*D. C. Bostwick & Son,	Ripley, N. Y.,	9
*M. E. Kelly,	North East,	4
*A. J. Youngs,	North East,	4
*W. E. Smith,	North East,	3
Emil Laurent,	Girard,	2

Fayette County.

J. Sterling & Son,	Masontown,	10

Franklin County.

J. W. Zook,	Chambersburg,	½
Geo. H. Wert (Forester),	Mt. Alto,	1
Henry Eicholz,	Waynesboro,	1
W. B. Reed,	Chambersburg,	¼

Fulton County.

Eli Covalt,	Covalt,	1

Juniata County.

*Elmer W. Graybill,	Richfield,	2
Jos. H. Landis,	McCullough's Mills,	3
*Augustus Frantz,	Richfield,	1
*S. H. Graybill,	Richfield,	5

Lackawanna County.

*George H. Colvin,	Dalton,	2
*Floyd H. Northup,	Glenburn,	2
John W. Shepherd,	Scranton,	4

*Grow berry or small fruit plants only.

Lancaster County.

Name.	Place.	Acres.
John G. Engle,	Marietta,	6
A. H. Erb,	Lititz,	½
Maurice Brinton,	Christiana,	20
W. P. Bolton,	R. F. D. McCalls Ferry,	2
D. D. Herr,	Lancaster,	5
H. H. Harnish,	Hubers,	2
Wilson Kready,	Mt. Joy,	1
Calvin Cooper,	Bird-in-hand,	2
O. W. Laushey,	Bird-in-hand,	2
A. W. Root & Bro., R. D. No. 1,	Manheim,	20
David S. Herr,	Mountville,	2
M. H. Musser,	Lancaster,	2
M. A. Kolp,	Elizabethtown,	1
B. F. Barr & Co.,	Lancaster,	3
Frank A. Suter,	Lancaster,	½

Lawrence County.

J. W. Hayes, R. D. No. 3,	Edinburg,	1
Butz Bros.,	New Castle,	1
A. S. Moore,	New Castle,	2
D. W. Fisher,	New Wilmington,	1
*Jas. R. Seley,	New Wilmington,	¼

Lehigh County.

W. B. K. Johnson,	Allentown,	30
Preston Kline,	Coopersburg,	1

Luzerne County.

I. A. Driggs,	White Haven,	
(Handles only native ornamental shrubs.)		
M. A. Maffett,	Wilkes-Barre,	1

Lycoming County.

Evenden Bros.,	Williamsport,	2

Mercer County.

*George E. Brocklehurst, R. D. No. 20,	Jackson Centre,	2½
*J. E. Brocklehurst, R. D. No. 3,	Mercer,	1½
*J. W. & J. H. Allison, R. D. No. 10,	Mercer,	10
*J. T. McLane, R. D. No. 46,	Greenville,	4
*Hugh Hogue, R. D. No. 28,	Carlton,	2½
J. L. Hoobler & Sons, R. D. No. 34,	Hadley,	4
*W. A. Taylor, R. D. No. 34,	Hadley,	4
*W. R. Cribbs,	Mercer,	3
*H. W. Allison, R. D. No. 9,	Mercer,	2

*Grow berry or small fruit plants only.

Montgomery County.

Name.	Place.	Acres.
Chris Koehler,	Cheltenham,	2
R. B. Haines & Co.,	Cheltenham,	2
C. H. Wilson,	Gladwyne,	2
J. B. Heckler,	Lansdale,	4
J. W. Thomas & Sons,	King of Prussia,	70
J. Krewson & Sons,	Cheltenham,	15
T. N. Yates & Co.,	North Wales,	100
J. B. Moore,	Hatfield,	10
Adolph Mueller,	Hoyt,	40
T. Meehan & Sons, Inc.,	Dreshertown,	200
Wm. Sturtzbecker,	Lansdale,	½
Edward D. Droun,	Weldon,	¼

Northampton County.

Theodore Roth,	Nazareth,	2

Northumberland County.

Joseph Harris,	Shamokin,	¼

Perry County.

Geo. A. Wagner,	Alinda,	5

Philadelphia County.

W. W. Harper,	Chestnut Hill,	500
Thos. Meehan & Sons, Inc.,	Germantown,	75
T. N. Yates & Co.,	Germantown,	4
John B. Lewis,	Bustleton,	10
A. F. O'Connell,	Philadelphia,	10
John Stephenson's Son,	Oak Lane,	2

Somerset County.

Village Nurseries,	Harnedsville,	37
H. E. Daniels,	Harnedsville,	7

Susquehanna County.

*E. A. Smith,	Heart Lake,	4
*Geo. Sprout,	Montrose,	5
*B. D. Hinds,	Montrose,	2

Venango County.

Venango Nursery Co., R. D. No. 1,	Franklin,	6

*Grow berry or small fruit plants only.

PLATE XIV. Pear Fruit Clusters showing injuries by the Leaf Blister-Mite (*Eriophyes pyri* (Pgst) Nal.) Kindly loaned from Bulletin No. 283, New York Agricultural Experiment Station, Geneva, N. Y., by Dr. W. H. Jordan. Pennsylvania readers are requested to watch for evidences of this pest and send specimens from both Pear and Apple to the office of H. A. Surface, Economic Zoologist, Harrisburg, Pa.

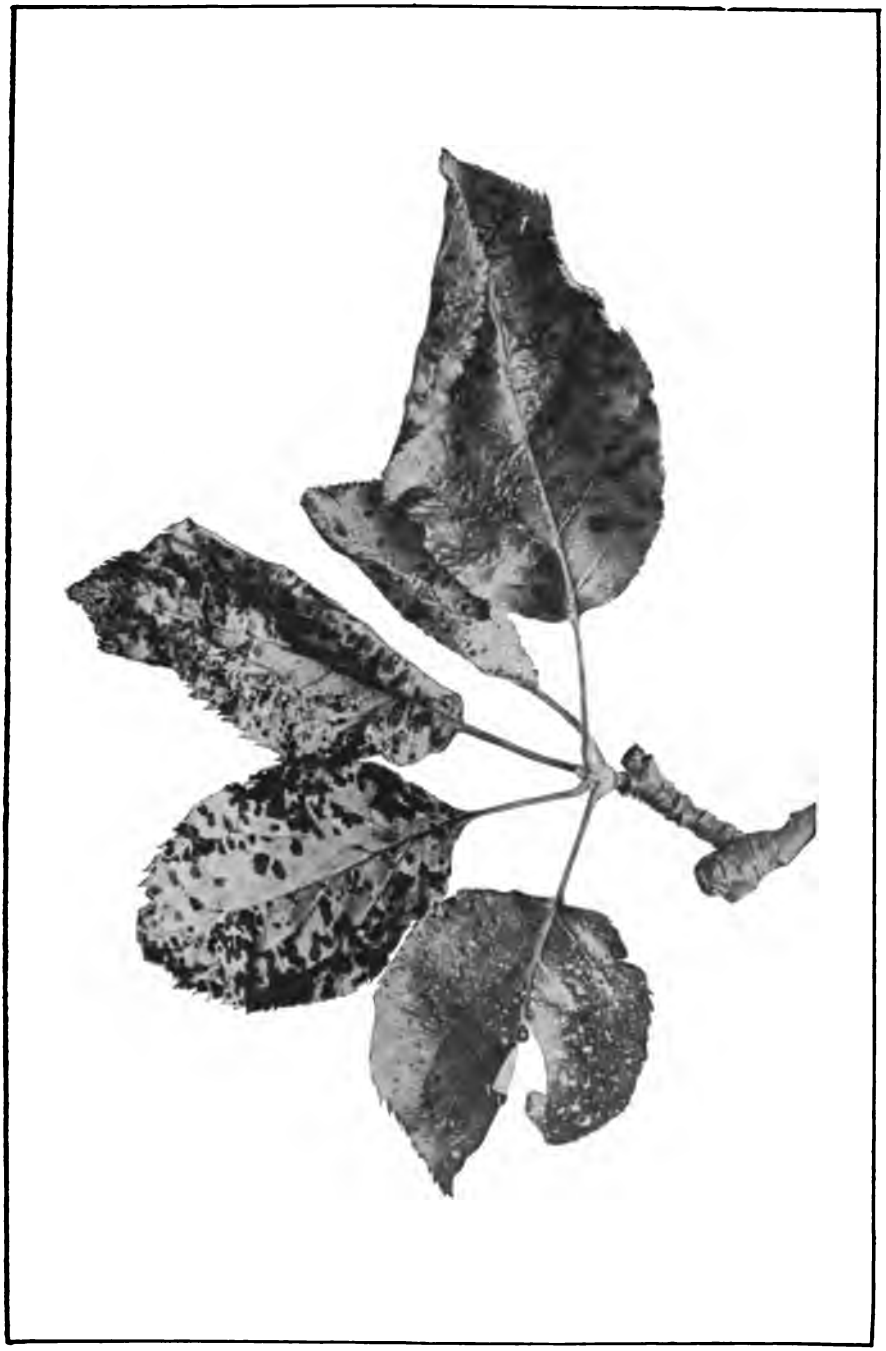

PLATE XV. An Apple Leaf Cluster injured by the Leaf Blister-Mite (*E. pyri* (Pgst) Nal.) Kindly loaned from Bulletin No. 283, N. Y. Agr. Experiment Station, Geneva, N. Y., by Dr. W. H. Jordan.

Westmoreland County.

Name.	Place.	Acres.
John McAdams,	Mt. Pleasant,	2

Wyoming County.

*Silas Decker,	Square Top,	5
*F. H. Fassett,	Meshoppen,	1

York County.

Patterson Nursery Co.,	Stewartstown,	12
Geo. E. Stein,	East Prospect,	6
W. S. Newcomer,	Glenrock,	4
E. J. Weiser, R. D. No. 11,	York,	½

ORCHARD INSPECTION AND DEMONSTRATIONS.

At the present time there are competent inspectors assigned to certain districts of Pennsylvania, who are making inspections of premises for detecting the presence of most of the serious pests which are responsible for the annual destruction of at least twenty-five million dollars worth of property in this State. The chief pest for which they are inspecting is the dreaded San José Scale, which must be detected before the infested trees, bushes, shrubbery or hedges are destroyed by it, if we wish to preserve them. There is no great difficulty in killing the San José Scale, and in saving the infested plants if the work be done by the right material (boiled Lime-sulfur Solution), in the right way (by thoroughly spraying with two coats or applications), and at the right time (when the leaves are off the trees).

During the summer our chief purpose is to detect the scale and other serious pests and give instructions as to the presence of this and other pests and render such help as is possible toward suppressing them. This fall as soon as the leaves drop, we shall commence to give public demonstrations of the methods of spraying for the San José Scale and other scale insects. Other demonstrations, for other pests, will be given in the proper season and duly announced in newspapers and by posters.

*Grow berry or small fruit plants only.

While we have not enough men nor funds to send one person into each county simultaneously, we can divide the State into districts and inspect a portion of each district. At the present time inspections are being made in the following counties by our inspectors and demonstrators, as follows:

Name of Inspector.	Headquarters.	County Being Inspected.
M. L. Benn,	Coudersport,	Potter.
James Bergy,	Mifflintown,	Juniata.
E. C. Bowers,	East Petefsburg,	North Lancaster.
J. S. Briggs,	800 Green St. Norristown,	Montgomery.
J. W. Cox,	New Wilmington,	Lawrence.
F. R. Fertig,	Lebanon,	Lebanon.
A. O. Finn,	Clifford,	Lackawanna.
T. C. Foster,	Winfield,	Union.
J. D. Herr,	Keystone House, Kutztown.	Berks.
D. A. Knuppenberg,	Lake Cary,	Wyoming.
R. F. Lee,	Bedford,	Bedford.
E. L. Loux,	Souderton,	Bucks.
Frank McClure,	Care of Mrs. Jane Cox, R. F. D. 34, Evans City.	Butler.
A. L. McKibben,	New Sheffield,	Beaver.
B. S. Moore,	Kulpsville,	Schuylkill.
C. E. Myers,	Forksville,	Sullivan.
J. K. Owen,	Dallas,	Luzerne.
M. E. Shay,	Tacony,	Delaware.
G. W. Sloop,	West Indiana House, Indiana.	Indiana.
A. W. Stephens,	Lewisburg,	Northumberland.
Francis Windle,	West Chester,	Chester.
J. W. Woolman,	Hotel Monahan, Greensburg.	Westmoreland.

All of our inspectors are provided with printed cards, showing that they are agents of this Department, and each is also given a certificate of credentials and appointment, bearing the seal of this Department. There have been a few cases of impostors found passing as our representatives, but such care is now taken to prevent imposition on the public that we think it will not be repeated.

It should be remembered that our inspectors make no charge for their services, have nothing to sell, take no orders for any goods, buy no products nor fruits of any kind for any firm, are working for the State upon salary, and are required to give their full time, with a full and proper number of hours per day, to the service in which they are engaged. While their chief duties are to make inspections during this portion of the year and to give demonstrations where and when needed, they are also prepared to meet farmers, fruit growers, truckers and gardeners in meetings of any kind where their

services are needed and give addresses upon topics pertaining to the work for which they have been especially qualified. It would be a good plan for the Granges, Farmers' Alliances, and other organizations and agricultural societies, etc., to avail themselves of the free service of the inspectors in their respective counties, and at the same time actively and definitely take up the work of co-operating with these men who are going through their counties with microscopes searching in detail for the pests that are destroying their crops. Whatever plans of co-operation may be attempted in each and every county will have the full approval and help of this office. We earnestly solicit for our inspectors the confidence and encouragement of the public, and if any man on our force should prove to be incompetent or in any way unworthy we ask to be informed of the full facts of the case, with evidences bearing upon it, in order that the proper steps can be taken promptly in regard to the same.

THE STALK-BORER.

An insect that is becoming quite prominent and destructive in this State, and of which we shall received many inquiries during the latter part of the summer, is known as the Stalk-borer, scientific name *Papaipema nitela*. While this pest makes itself conspicuous by infesting a great many kinds of cultivated plants, including truck crops as well as flowers, it also unfortunately attacks weeds of nearly all kinds that have stems large enough to sustain it. Its ability to live in the stems of weeds makes it possible for it to exist in a region where careful farming and gardening would exterminate it by means that might be employed with efficiency.

The Stalk-borer does serious damage to plants by entering the stem or stalk as a small larva, the egg being laid at the base of the plant stalk by a moth, hatching during the early part of July, and boring into the centre of the plant stalk and then upward, eating as it goes, and enlarging the cavity in the interior of the plant. In this manner it may cause the plant to break or wither and fall. Often wilting of such plants as tomatoes, potatoes and others is due solely to this pest. If a stalk, which has almost suddenly wilted, be split open lengthwise, there can often be found the dark-stained tunnel left by the Stalk-borer, and the pink-striped "worm" or larva itself often can be found near the top of the burrow or preparing to bore its way out, so that it can enter the ground to pupate or become a chrysalis.

Since the Stalk-Borer feeds entirely upon the interior of the plant, there is no way of reaching it by insecticides, and it is not possible to detect its presence until its effects become so conspicuous and serious as to prove almost destructive to the individual plant which it inhabits.

When plants are seen to be drooping, wilting or turning yellow, it is best to cut them off and examine them and see if they be infested with such pests as those here described. If so, all such infested vines or stalks should be burned as promptly as possible, in order to destroy the pest and prevent its increase and spread during another season.

During some years the Stalk-Borer attacks the vines of tomatoes, as well as potatoes, in great numbers, and does really considerable injury. For this reason it is of imperative importance that as soon as possible after the tomatoes are gathered or the potatoes lifted from the ground, all the stalks should be raked or harrowed together and burned by throwing them on a hot brush fire while they are yet green or as green as they can be gathered at the time. The point is, that they should be burned before they have become entirely dry enough to burn alone, as the pests will probably leave them before they reach that stage. The importance of pulling or cutting infested stalks and burning them as soon as the infestation shows can not be too greatly emphasized, as this is about the only means of combating this pest.

It should be remembered that this and other boring insects live in the stalks of weeds, and for this reason it is of the utmost necessity that all weeds large enough to sustain them should be cut and burned if the "worms" or larvæ have grown to anywhere near their maturity; or if the larvæ be yet small, it is sufficient to cut them and leave them lie on the ground, as the pests will not mature if they do not have stalks of plants in which to continue to bore and feed. For this reason it is most excellent practice to mow the weeds of Lambsquarter, Ragweed, Hog Ragweed, Bullweed, Artichoke, and in fact all other weeds large enough to sustain such borers—mowing them about the middle of the summer and again the latter part of August. If the weeds were not mowed during the latter part of July they should be mowed now at once, and if the larvæ be not mature it will not be necessary to burn them, but if they be fully an inch in length they are probably large enough to undergo their transformations and appear in increased numbers during the next summer.

We have found the following plants infested with the Stalk-Borer *(Papaipema nitela)*, and this list shows the wide possibility of its

range: Tomato, Ragweed, Sweet Corn, Oats, Blackberry (?), Giant Ragweed, Potato, Elder (?) Corn, Gooseberry, Lily and Borrage.

Summary.—Pull or cut infested plants as soon as they are seen to wilt or found infested, and mow the weeds everywhere on the premises, at least twice during the summer.

HOUSEHOULD FUMIGATION.

Mr. H. A. Surface, Harrisburg, Pa.:

Dear Sir: I want to fumigate an old log house with Hydrocyanic Acid Gas or some other equally good gas, for bed bugs, ants, moths, etc. We are living in the house which is a one and one-half story, 28 feet by 20 feet, ground floor measurement.

The down stairs outer walls and the middle partitions have been covered with heavy building paper and over it wall paper. Up stairs the side walls—about four feet high—are daubed and plastered in the regulation fashion (as are also the walls down stairs, over which we have papered) and have been whitewashed.

The ceiling overhead and down the slope to the side wall is ceiled with close fitting boards. The gable ends are also ceiled with boards.

Please give me the necessary directions for doing the fumigating. I want, if possible, to rid the house of all the above mentioned pests, especially the bed bugs, which I believe come down from the roof.

Will it be necessary to remove furniture and clothing, and will the gas injure clothing in any way?

A prompt reply will be greatly appreciated.

Yours very truly,

X. X. X.

Harrisburg, Pa., July 16, 1907.

Dear Sir: Replying to your letter of the 15th, asking about the method of fumigating a house for household pests, I beg to say that this is a very important subject at this time of year. It is so easy to fumigate and kill all pests in houses that I am surprised that persons should suffer with insects, or even with rats and mice in their buildings, when the structures are tight enough to retain the poisonous gas for one-third hour or more. Of course, where the building is very loosely constructed, so that the air readily blows through it is almost impossible to fumigate with good results. However, there should be far more fumigation done in most of the houses of this State this summer than will be undertaken, and although it is an easy process and perfectly safe when done with sufficient care, it is indeed quite dangerous if not given full and careful attention.

A building as closely constructed as an ordinary dwelling house can be successfully fumigated, and all flies, bedbugs, ants, mice and rats in the rooms or in the walls can be killed. The material to use is a gas known as Hydrocyanic Acid Gas, which is made by putting Cyanide of Potassium or the deadly Prussic Acid into Sulfuric Acid and water. As soon as the Sulfuric Acid comes into contact with the Cyanide a deadly gas is given off, and to fill the lungs with it twice would cause instant death. As alarming as this statement may appear, it is possible to handle this material with perfect safety by following the directions here given. Ascertain the number of cubic feet in each room to be fumigated, and divide it by two hundred. This gives the number of ounces of Cyanide of Potassium to use as we recommend one ounce of Cyanide of Potassium for each two hundred cubic feet of space in each room. A little surplus of material will be better than an underdose. Compute the number of ounces of the Cyanide of Potassium needed for each and every room, and add these amounts together, and thus learn how much Cyanide will be needed, and then multiply this by two, and it will give you the number of ounces of Sulfuric Acid that will also be needed for the entire building. Order the Cyanide of Potassium and Sulfuric Acid of the local druggist or of a wholesale firm, such as Powers-Weightman-Rosengarten, Philadelphia, Pa. The Cyanide of Potassium should be 98 per cent. pure, and the Sulfuric Acid need be only the commercially pure, but should not be lighter than 1.83 specific gravity. Even though persons ordering the material do not know what this means, the druggist will know, and will furnish the material required to give proper results. Of course, directions should be given that they be not shipped in the same package for the reason that if the acid should break and come in contact with the Cyanide, it might cause serious results in any car or room.

After determining the cubic capacity of each room and ascertaining the number of ounces of Cyanide of Potassium that will be needed for fumigating each respectively in the proportion of one ounce for each two hundred cubic feet of space, the material should be carefully weighed or measured on scales sufficiently delicate to give accurate weights of an ounce or the fraction of an ounce. If one does not have such scales, he can take the material in small paper sacks to the store and there have it weighed. Put the Cyanide of Potassium into small paper sacks, putting into each sack the exact amount of material needed for each respective room, and mark on the outside of the sack the room for which it is intended, so that it can be placed in its respective room in the house upon returning.

Of the Sulfuric Acid two fluid or liquid ounces are to be used for each ounce by weight of the Cyanide of Potassium. This means

that on a druggist's graduate it should measure two ounces of Sulfuric Acid for each ounce of the Cyanide of Potassium needed for each respective room, and pour this into a bottle and label it for the room to which it is destined. Carry the Cyanide and the acid in separate receptacles to the house and to the rooms where they are needed. Spread several thicknesses of newspaper over the carpet in the middle of each room to be fumigated, and into earthen or stoneware vessels pour twice as many ounces of water for each respective room as the amount of the Sulfuric Acid for that room. This, of course, would be twice as many ounces of water by measure as Cyanide by weight. Do not use metal vessels for containing this liquid nor wooden vessels with metal hoops. The acid will be sure to destroy them and may give serious results in injuring the carpets. As leakages occur from the corrosive effects, pour the water into earthen, stone or granite vessels and pour the Sulfuric Acid into this. Put the small bag of Cyanide of Potassium on the floor beside the vessel containing the dilute acid. See that all the openings in the room are tightly closed, excepting the door through which the operator must pass out. Have the windows closed and the curtains drawn down, and if the windows do not fit tightly, stop them with cotton or damp strips of paper. Begin in the attic or upstairs rooms first. Get everything in readiness in all the rooms by having the acid poured into the water, and have the Cyanide in paper bags on the floor beside it. Pass from one room to another and drop the small paper bag of Cyanide into the vessel containing the dilute acid, and leave the room immediately and close the door tightly. Of course, if it be necessary to pass from one room to another in order to perform the fumigation of another room, the further room should be treated first and the bag should be dropped into the diluted acid in the second room on the way back. After treating the attic rooms, pass downstairs, and drop the Cyanide into the vessel in the upstairs rooms, and go on down and treat the rooms downstairs in the same way, being sure first that all doors and windows are closed, excepting those that will be needed for the passage of the operator. Of course, it will not be necessary to lock the doors if persons be warned or guarded against entering the house during the time of fumigation.

It will not be necessary to fumigate the basement or cellar, unless there be pests that are to be killed there, as the Hydrocyanic Acid Gas will not penetrate holes in the cellar walls and kill rats and mice that may be found there. For this particular purpose a liquid generating a heavier gas is used, and this liquid is Carbon Bisulfid, which is to be poured into the holes, and they should then be stopped with clay. The Carbon Bisulfid is explosive like benzine or gasoline, but the Cyanide of Potassium does not give off inflammable or explo-

sive fumes. Thus there is no real danger from fire in a stove during the time of fumigation.

Permit the house to remain closed for an hour or two and then open the outside doors, and let the air blow through, and by the use of a ladder or by having previously attached strings or ropes to nails, it is possible to open the windows from the outside and ventilate in this way. However, if for any reason one can not open the windows from the outside, he can by holding his breath and absolutely refraining from breathing, enter the room to be ventilated, throw up the windows and retire from it without inhaling. We have done this successfully on several occasions in our experimental work. It is even possible to occupy downstairs rooms while fumigating the rooms upstairs. This, of course, is to be done only by giving as full and free ventilation to the lower and occupied rooms as can possibly be made. However, we have seen this done successfully with no evil results whatever, yet it is probable that the best results are to be obtained from fumigating an entire house and leaving it closed for two hours.

It will not be necessary to remove from the house anything whatever excepting plants and pets that should be preserved. Growing plants left in rooms will be severely scorched, and any pets like birds or cats would be killed if left behind. The gas will not injure the most delicate fabrics or clothing, nor even food material. We have fumigated mills with this formula, and have cleaned them of the terrible pest known as the Mediterrenean Flour Moth, and afterwards made bread from fumigated flour, and have used it without any evidence of deterioration of quality due to fumigation. It is desirable that the gas should enter closets, bureau drawers and other articles of furniture that are usually kept closed, and for this reason that should be opened before the fumigation is made, and left open during that time.

The cost of fumigation is so slight that it is insignificant compared to the great amount of comfort it will bring when houses are infested with any of the ordinary insects of the household. By buying our Cyanide of Potassium in quantity, it costs us but twenty-seven cents (27c) per pound. Of course, to this the freight or express charges must be added, but if one should pay fifty cents (50c) per pound for Cyanide of Potassium at retail druggists, and five cents (5c) for the Sulfuric Acid, the cost of fumigation would not be sufficient to justify a person suffering from household pests of any kind. For example, in the particular case cited in the original inquiry, the house is said to be one and one-half stories, 28x20 feet. The exact height for area to be fumigated is not given, and consequently the cubic contents can not be ascertained with precision.

but presuming this to be 20 feet, the volume of the house, even by outside measurements would be 28x20x20, which is 11,200, divided by 200 in order to ascertain the number of ounces of Cyanide of potassium gives 56, or 3½ pounds. It is probable that the inside measurements would show that about 3 pounds of Cyanide of Potassium are needed for this fumigation, at 50 cents per pound, this would cost only $1.50, and twice as much Sulfuric Acid at 5 cents per pound would cost only 30 cents, making the straight cost only $1.80 for the total fumigation, which should rid the house of pests and keep it clean until next spring, when a second fumigation will be justified.

The time required for doing the actual work is very slight, indeed, as any ordinary dwelling house can be prepared for fumigation, and all of the ingredients be procured and the actual fumigation commenced within an hour of time by the operator. Considering the ease, certainty, etc. with which the work is done we recommend it as a general means of relieving trouble with all household pests, such as flies, fleas, roaches, ants, bedbugs, clothes moth, carpet beetles and other insects, and only give the one warning as to the necessity of extreme care in avoiding breathing the gas after the Cyanide is dropped into the acid.

H. A. S. Economic Zoologist.

FUMIGATING SEEDS.

Dear Sir: I would like to save my own garden seed. I have a fine lot of dry peas, which I would like to save for seed next year. How can I treat them to keep the weevil out, or prevent the borers that perforate them?

Thanking you for past favors, I am,

Very truly yours,

R. N.

Mr. R. N., Falls Schuylkill, Philadelphia, Pa.:

Dear Sir: Replying to your recent letter, asking how you can keep such garden seeds as peas from the Weevil destroying them until you wish to plant them again in the spring, I beg to say that this can be done without great difficulty and without injuring the germinating quality of the seeds, by fumigating them with Carbon Bisulfid. The seeds should be placed in a vessel that can be tightly closed, and a flat dish like a plate or pie pan should be placed on them, and into this should be poured the liquid Carbon Bisulfid, after which the vessel should be closed tightly, and left closed for at least two or three hours. The amount of Bisulfid of Carbon to use, of course, depends upon the amount of seed to be treated. The

usual formula is one pound for ten bushels. However, there is not much danger of using too much, and for a few seeds it is well to put them into a wash boiler, and pour the Carbon Bisulfid into a dish over them, put on the lid and put a wet blanket over it to prevent the leakage of gas around the edges and let it remain for about three hours. Open it in the wind so as to prevent breathing the gas which has come from the liquid, which has formed by the evaporation of the liquid. Fire should be kept away from both the liquid and the fumes as these are explosive, but otherwise it is not especially dangerous.

Seeds and grains are not injured for germinating nor for food purposes by this treatment, but the pests which they contain are destroyed with certainty. In some cases it is possible that the insects in the egg stage will be present just at the time of fumigation, in which case the egg is not so susceptible to destruction by the fumes as the insects half grown, and for this reason it may be advisable to give a second fumigation a short time after the first, but for most insects, such as the Weevil, all that is necessary is to fumigate once to destroy thoroughly and properly all pests, and then place the seeds or grain in double paper sacks and tie them tightly and put them away and keep them for future use.

Hoping this gives you the full information you need, and offering you our further services when possible, I am,

Very truly yours,

H. A. SURFACE,
Economic Zoologist.

SPECIMENS RECEIVED DURING JUNE, 1907.

Number.	Specimens.	Date—June, 1907.	Name and Address.
	Insects.		
9273	(b) Oyster-shell Scale ..... (c) Canker Worm Eggs, ... (d) Tiger Beetle (C. 6-guttata), ...	1	Mrs. J. U. Moore, Transfer.
9274	(a) Corn Bill-bug (Sphenophorus sculptilis.) (b) Fly larvæ, ...	3	D. Stout, Middletown.
9277	Corn Bill-bug (S. sculptilis), ...	3	W. W. Climenson, Honey Brook.
9278	Work of Leaf-eating Beetle (Prob. Paria sp.)	3	F. B. Yockey, Apollo.
9279	(a) Long-horn Beetle (Saperda obliqua). (b) Wood Borer (Prionus laticollis).	4	W. W. Climenson, Honey Brook.
9282	Insects, ...	4	J. F. and G. M. Landis, McCulloch's Mills.
9287	Terrapin Scale (E. nigrofasciatum), ..	4	S. E. Swartz, Harrisburg.
9288	Work of Flour Moth (Pyralis farinalis).	4	L. A. Hill, Leechburg.
9289	Insect Galls (Rhodites bicolor), ...	4	E. Moran, Lock Haven.
9290	(a) Scurfy Scale, ...	4	H. C. Heilman, Montgomery.
9292	Scale Insect, ...	4	Mrs. W. T. Langdon, Eldred.
9295	(b) Biting Flies (Tabanidæ), ...	5	G. and J. Landis, McCulloch's Mills.
9297	(a) San José Scale, ... (b) Work of Leaf-eating Beetle on Raspberry Leaves.	5	J. I. Dauman, Honey Brook.
9298	Oyster-shell Scale, ...	5	Mrs. H. J. Cooper, Taylor.
9299	Cherry Aphids, ...	5	W. H. McElwee, Harrisburg.
9300	Coleoptera, ...	5	G. R. Pritchard, Harrisburg.
9306	Wolf Flies, ...	6	Geo. Von Neida, Womelsdorf.
9308	(a) Oyster-shell Scale, ...	6	N. J. Wells, Tunkhannock.
9311	Oyster-shell Scale, ...	7	D. P. Carrier, Corry.
9315	Bagworm Cocoon (T. ephemeraeformis).	7	H. H. Hawkins, Springforge.
9316	Scurfy Scale, ...	7	J. A. Hutchinson, Claysville.
9317	San José Scale, ...	7	C. L. Burgess, Lovelton.
9318	Work of Twig Pruner (Acrobasis rubrifasciella).	7	F. B. Brown, West Leesport.
9327	(c) Wooly Bear (Diacrisia virginica),	10	G. and J. Landis, McCulloch's Mills.
9329	Cecropia Moth, ...	10	J. R. L. Heichhold, Clearfield.
9330	(a) Cherry Aphids, ...	10	J. F. Dymond, Uniontown.
9331	(b) Rear Horse Beetle (Staphylinus maculosus). (c) Ground Beetle (Scarites subterraneous).	10	W. C. Dickson, Wayne.
9332	Currant Aphids, ...	10	L. E. Hobbs, Logan, Philadelphia.
9333	San José Scale, ...	10	Mrs. H. B. Harrison, Olney, Philadelphia.
9334	Rhubard Snout Beetle (Lixus concavus).	10	Miss C. B. Steele, Tioga.
9335	(a) Currant Aphids, ... (b) Cherry Aphids, ...	10	W. H. Shatto, West Fairview.
9337	Oyster-shell Scale, ...	10	D. H. Meck, New Bloomfield.
9338	Terrapin Scale (E. nigrofasciatum), ..	10	Miss C. Lewis, Bryn Mawr.
9339	(c) Oyster-shell Scale, ...	10	Mrs. M. M. Hildebrant, Mt. Joy.
9342	Corn Bill-bug (S. sculptilis), ...	10	A. B. Grubb, Annville.
9343	Giant Water Bug (Benacus griseus), ..	10	G. J. Wimmer, Nazareth.
9344	Stonefly Nymphs, ...	10	L. R. Donleay, Etters.
9354	Eyed Elater (Alaus oculatus), ...	11	W. H. Schuchers, Reynoldsville.
9357	Polyphemus Cocoon, ...	11	M. M. Gettel, Shippensburg.
9358	Sphinx Moth (P. carolina), ...	11	J. E. Creamer, Shippensburg.
9359	New York Plum Scale (E. prunastri),	11	G. M. Wilson, Muddy Creek Forks.
9360	Cherry Juice gathered by Bees, ...	11	Prof. F. G. Fox, Erwinna.
9361	Wireworms, ...	11	W. Kohr, Penbrook.
9364	Cabbage Root Maggot, ...	11	M. M. Fulton, Boiling Springs.
9367	Magnolia Scale, ...	11	F. A. Russel, Pittsburg.
9369	San José Scale, ...	11	J. A. Megargee, Coatesville.
9370	Wireworms, ...	11	Dr. Kalbfus, Harrisburg.
9379	(a) Leaf-eating Beetle (Paria 4-guttata.) (b) Strawberry Crown Borer (Otiorhynchus ovatus).	12	A. Deming, Lawrenceville.
9380	Euonymus Scale (Chionaspis euonymi),	12	J. D. Wentling, Greensburg.
9381	Carpet Beetle larva (A. scrophulariae),	12	A. B. Thompson, Mercer.
9382	Cherry Aphids, ...	12	D. R. Sechler, Danville.
9383	Giant Water Bug, ...	12	B. P. Strunk, Utahville.
9384	Saw-toothed Granary Weevil (Silvanus surinamensis).	12	M. R. Good, Narvon.
9386	Cherry Aphids, ...	12	A. W. Brumgard, Lock Haven.
9392	Lecanium, ...	13	J. G. Dillin, Brownsburg.
9393	May Beetle (Lachnosterna sp.), ...	13	J. W. Zaum, Norristown.

SPECIMENS RECEIVED DURING JUNE, 1907—Continued.

Number.	Specimens.	Date—June, 1907.	Name and Address.
9394	(a) Cutworms, (b) Clover-leaf Beetle larvæ,	13	J. H. Rupp, Shiremanstown.
9396	(a) Cherry Aphids,	13	V. O. Switzer, Danville.
9397	Wireworms,	13	O. Springer, New Sheffield.
9398	(a) Oyster-shell Scale,	13	N. MacEwen, Kane.
9401	(b) Oyster-shell Scale,	14	E. M. Mixer, Union City.
9403	Scurfy Scale,	14	F. Field, Dunkard.
9407	Insects,	15	K. Geist, Covington, La.
9408	Wolf Fly,	15	E. C. McCullogh, Newville.
9410	Clear-wing Sphinx (Hemaris axillaris),	15	W. J. Young, Springville.
9420	(a) Noctuid larvae, (b) Moth larva,	17	A. Shoff, Colemanville.
9421	(a) Oyster-shell Scale,	17	W. J. D. Rose, Murrysville.
9425	Crane Flies,	17	R. Coover, Harrisburg.
9426	Corn Bill-bug (S. sculptilis),	17	W. W. Walton, Nine Points.
9427	Insects (4 species),	17	F. Anderson, Geneva.
9430	Oyster-shell Scale,	17	F. O. Hall, Conneautville.
9432	Ichneumon Wasp (Thalessa atrata),	17	S. Heisel, Queen.
9435	(b) Yellow Swallow-tail Butterfly (P. g. turnus). (c) Round-headed Apple-borer (Saperda candida).	17	S. Tooker, Easton.
9444	Pine Scale (Aspidiotus abietis),	18	Frank M. Day, Mt. Airy.
9445	(a) Fly gall (Cecidomyia pellex), (b) Apple-leaf Crumpler (Mineola indiginella.) (c) Basket Worm Cocoon (T. ephemeraeformis.)	18	J. W. Fryling, Sunbury.
9446	Corn Bill-bug (S. sculptilis),	18	M. R. Hinsdale, Sugargrove.
9447	Parasitic Wasp (T. lunator),	18	I. M. Tuthill, Upper Darby.
9448	Giant Water Bug (B. griseus),	18	T. E. Williams, Kittanning.
9449	(a) Terrapin Scale, (b) Oyster Shell Scale, (c) Putnam Scale, (d) Cherry Scale,	18	A. M. Gingling, Altoona.
9450	Oyster-shell Scale,	18	A. C. Schant, St. Mary's.
9451	Potato Flea Beetles,	18	W. H. Brandt, Chambersburg.
9452	Oyster-shell Scale,	15	R. H. Knowlton, Tiadaghton.
9453	(a) Currant Aphids, (b) Cherry Aphids,	15	O. Weaver, Millersburg.
9454	Sphinx Moth (Paonias excaecatus),	18	Mrs. T. D. McElderry, Transfer.
9456	Noctuid Pupa,	18	Dr. I. M. Weills, Harrisburg.
9460	(a) Oyster-shell Scale, (c) Aphids,	18	N. J. Wells, Tunkhannock.
9468	Scurfy Scale,	19	J. A. Breakey, Stanton.
9470	Lecanium on Rose,	19	J. A. Patterson, Stewartstown.
9472	Oyster-shell Scale,	19	S. C. Williams, Wynnewood.
9473	Insects,	19	U. E. Smith, Monroeton.
9474	(a) Yellow Swallow-tail Butterfly, (b) Io Moth,	19	Miss J. E. West, Danville.
9484	(b) Arctiid Moth (Estigmene congrua).	20	H. K. West, Danville.
9486	Bombardier Beetle (Calosoma scrutator.)	20	W. H. Kehl, East Greenville.
9487	Insects,	20	Miss E. P. Williams, Haverford.
9488	Lecanium,	20	J. Miller, Danville.
9490	(a) American Giant Water Bug (Belostoma americana.) (b) Calosoma scrutator,	20	G. R. Pritchard, Harrisburg.
9491	Chalcid Flies,	20	C. S. Anderson, Harrisburg.
9493	(c) Long-horn Beetle,	20	R. L. Jackson, McConnellsburg.
9494	Aphids,	20	J. E. Roberts, Danville.
9495	Cherry Aphids,	20	K. O. Thompson, Danville.
9497	(a) Oyster-shell Scale, (b) San José Scale,	20	E. B. Buckalew, Harrisburg.
9506	Benacus griseus,	21	G. S. Gerhardt, Harrisburg.
9507	Rose Chafers (Macrodactylus subspinosus).	21	M. B. Rowland, Jr., Fox Chase, Phila.
9508	Tortoise Shell Beetle (Coptocycla clavata).	21	E. B. Maule, Cochranville.
9509	Mole Cricket,	21	Miss E. E. Swartz, Newburg.
9510	Luna Moth,	21	Mrs. J. G. Gilbert, Waterford.
9511	Rose Chafers,	21	S. Hartley, Dunkard.
9512	(b) Work of Flea Beetles,	21	J. S. Hicks, Granville.
9514	8-spotted Forester (Alypia 8-maculata).	21	G. Houseal, Harrisburg.
9516	(a) Cherry Aphids, (b) Aphids on Quince,	21	W. M. Brosha, Antes Fort.
9517	Aphids,	21	G. R. Pritchard, Harrisburg.

SPECIMENS RECEIVED DURING JUNE, 1907—Continued.

Number.	Specimens.	Date—June, 1907.	Name and Address.
9518	Bagworm Cocoons,	21	T. Oxford, Jr., Bangor.
9519	(a) Terrapin Scale, (b) Aphids,	21	D. Owen, Harrisburg.
9528	Eyed Elater,	22	C. Revie, Harrisburg.
9529	Giant Water Bugs,	22	C. F. Strickland, Kingston.
9530	Luna Moth,	22	Mrs. N. Colegrove, Gaines.
9531	Aphids,	22	C. H. Rich, Woolrich.
9532	Ichneumon Wasp (T. lunator),	22	E. R. Buzzell, Curwensville.
9542	Oyster-shell Scale,	24	J. Pyle, Barondale.
9543	Oyster-shell Scale,	24	A. Russel, Emporium.
9544	Flat-headed Borer (Dicerca divaricata.)	24	J. C. Franke, Coudersport.
9545	Lady Beetle larva,	24	E. W. Cooper, Oak Lane.
9546	(a) Stink Bugs, (b) Bag Worm,	24	J. G. Oberdorf, Mifflinburg.
9548	Grape-vine Tomato galls (Lasioptera vitis).	24	Dr. G. Haine, Linglestown.
9550	(a) Scurfy Scale, (b) Oyster-shell Scale,	24	J. M. Phillips, Pittsburg.
9551	(a) Aphids, (b) Lightning Beetles,	24	F. Cobb, Nicholson.
9552	Fly Gall,	24	P. S. Tooker, Easton.
9553	(a) Aphids, (b) Click Beetle,	24	W. Haun, Sharpsville.
9554	Wooly Aphids,	24	J. R. Snavely, Harrisburg.
9555	(d) Measuring Worm,	24	Mrs. B. Moore, Kane.
9556	Cecropia Moth,	24	Miss S. Pentz, Montoursville.
9557	Cecropia Moth,	24	E. R. Spatz, Mt. Carmel.
9558	Noctuid larvae,	24	T. Messner, Warren.
9559	Belostoma americanum,	24	E. Love, Meshoppen.
9562	Coptocycla clavata,	24	F. P. Jones, West Springfield.
9563	Alaus oculatus,	24	A. Barkley, Harrisburg.
9572	(e) Dragon Fly Nymph,	25	B. Gleoggler, Tobyhanna.
9577	Oak Gall (Andricus seminator),	25	A. E. Fisher, Duncannon.
9579	Aphids,	25	R. A. Forsythe, Media.
9582	(a) Scurfy Scale,	25	G. F. Hoy, Hublersburg.
9583	Long-horn Beetle (Xyiotrechus colonus).	25	A. W. Young, Manheim.
9584	(a) Shot-hole Borers, (b) Rose Chafer, (c) Long-horn Beetle (Neoclytus erythrocephalus).	25	A. W. Sterrett, Oakville.
9585	(a) Oak Scale (Aspidiotus obscurus), (b) Rose Chafer,	25	W. W. Long, Washington.
9586	Cherry Aphids,	25	B. M. Stone, Stull.
9587	May Beetle (Lachnosterna spp.),	25	H. F. Shafer, Stroudsburg.
9590	Benacus griseus,	25	Dr. O. T. Everhart, Hanover.
9601	Cherry Aphids,	26	W. Chase, Conneautville.
9603	Eyed Elater,	26	M. W. Strealy, Chambersburg.
9604	Cynip Gall,	26	A. B. Moore, Reynoldsville.
9605	Solitary Bee (Agapostemon nigrocornis).	26	H. T. Borhek, Bethlehem.
9606	(b) Work of Potato Flea Beetle,	26	R. J. Belt, Wellsville.
9607	Apple Aphids,	26	W. G. Winner, Calvert.
9608	Maple Aphids,	26	H. J. Heckert, York.
9609	Pine Scale (A. abietis),	26	Miss H. Harris, Aldan.
9610	Wooly Apple Aphis,	26	Hon. Frank Wickersham, Harrisburg.
9613	(b) Work of Potato Flea Beetles,	26	C. F. Bingaman, Beavertown.
9614	(a) Oyster-shell Scale,	26	R. W. Peters, Laurys Station.
9615	Maple Aphis,	26	J. O. Gardner, York.
9616	Pupae shells of Sesia pyri,	26	H. T. Couch, Carnegie.
9618	Cherry Aphids,	26	W. G. Hammer, Germantown.
9620	Lepidoptera Larvæ,	26	L. M. Simon, Linglestown.
9622	Spittle Insects,	26	J. A. Patterson, Innwood, W. Va.
9623	Diptera Galls (Lasioptera vitis),	26	J. A. Hand, Moosic.
9624	(a) Cherry Aphids, (b) Scurfy Scale,	26	A. Hiller, Fairhaven.
9628	Insects,	27	J. F. Landis, McCulloch's Mills.
9631	(b) Aphid Galls,	27	P. S. Tooker, Easton.
9632	Webworm,	27	W. W. Ritter, Harrisburg.
9635	Work of Potato Flea Beetle,	27	B. L. Heming, Shillington.
9644	(a) Maple Aphids, (b) Lightning Beetles (Chalioghathus marginatus).	27	A. B. Parker, Norristown.
9646	May Flies,	26	R. Coover, Harrisburg.
9647	(a) Striped Cucumber Beetle (Diabrotica vittata).	27	S. M. Peters, Belleville.
9656	Maple Aphids,	28	C. H. Best, Bethlehem.
9657	Elm Coxcomb Gall (Colopha ulmicola),	28	H. S. Bollinger, Lock Haven.

SPECIMENS RECEIVED DURING JUNE, 1907—Continued.

Number.	Specimens.	Date—June, 1907.	Name and Address.
9659	(a) Lady Beetle pupæ, ...	28	P. A. Bluhm, Nisbet.
	(b) Cottony Maple Scale (Pulvinaria innumerabilis).		
9660	(a) Cherry Aphids, ...	28	J. Hemminger, Carlisle.
	(b) Lady Beetle (Adalia bipunctata),		
9663	(b) Work of Potato Flea Beetles, ...	28	H. B. Haring, Camp Hill.
9664	Lightning Beetle (Podabrus rugulosus).	28	C. T. Bastian, West Wescosville.
9665	Shot-hole borers, ...	28	A. Schreiber, Dagus Mines.
9667	Insects, ...	28	J. F. Landis, McCulloch's Mills.
9678	(a) Rose Chafer, ...	29	R. L. Jackson, McConnellsburg.
	(b) Flea Beetle (Haltica chalybea),		
	(c) Ground Beetle (Lebia virdis), ..		
9680	(a) Rose Chafers, ...	29	J. F. Dymond, Uniontown.
	(b) Stalk Borer (Papaipema nitela),		
9681	Cherry Leaf Slug, ...	29	J. O. Gardner, York.
9683	(a) Stag Beetle (Lucanus dama), ..	29	Mrs. J. W. Atkinson, Buckingham.
	(b) May Beetle, ...		
	(c) Arctiid Cocoon, ...		
9684	Sphinx Moth (S. drupiferarum), ...	29	H. Merring, Kizers.
	Invertebrates not Insects.		
9282	(a) Millipedes, ...	4	J. K. and G. M. Landis, McCulloch's Mills.
	(c) Crustaceans, ...		
9290	(b) Mites, ...	4	H. C. Heilman, Montgomery.
9308	(b) Mites, ...	6	N. J. Wells, Tunkhannock.
9336	Maple-leaf Mite Galls, ...	10	J. W. Shepherd, Scranton.
9355	Millipedes, ...	11	G. A. Spring, Covington.
9398	(b) Mites, ...	13	N. McEwen, Kane.
9407	(f) Millipedes, ...	15	J. Geist, Covington, La.
9421	(b) Mites, ...	17	W. J. O. Rose, Murrysville.
9435	(a) Tick from Red Squirrel, ...	17	P. S. Tooker, Easton.
9450	(b) Mites, ...	18	A. C. Schaut, St. Marys.
9460	(b) Mites, ...	18	N. J. Wells, Tunkhannock.
9473	(f) Millipedes, ...	19	U. E. Smith, Monroeton.
9493	(b) Millipedes, ...	20	R. L. Jackson, McConnellsburg
9549	Red Mites, ...	24	T. E. Williams, Kittanning.
9572	(d) Crayfish, ...	25	B. Gleoggler, Tobyhanna.
9582	(b) Mites, ...	25	G. F. Hoy, Hublersburg.
9614	(b) Millipedes, ...	26	R. W. Peters, Laury's Station.
9627	(c) Spider Egg Mass, ...	27	J. Couch, Canonsburg.
9647	(b) Mites, ...	27	S. M. Peters, Belleville.
9661	Leech, ...	28	A. Cunkle, Harrisburg.
	Reptiles, Batrachians and Fishes.		
9628	Granite Salamander (Plethodon glutinosus).	1	W. R. McGinnis, Parker's Landing.
9289	(a) 2 Hellbenders (Cryptobranchus alleganiensis).	1	R. W. Wehrle, Indiana.
	(b) Queen Snake (Regina leberis),..		
	(c) Blacksnake (Bascanian constrictor).		
9275	Rattlesnake (Crotalus horridus), ...	3	F. G. Couch, Andersonburg
9280	Ring-necked Snake (Diadophis punctatus).	4	F. Mayer, Johnstown.
9285	(a) Common Water Snake (Natrix sipedon).	4	F. D. Keboch, Williamstown.
	(b) Rock Snake (Storeria dekayi),..		
	(c) 2 Granite Salamanders, ...		
	(d) 2 Newts (Diemictylus viridscens)		
	(e) Red Salamander (Spelerpes rubber).		
9296	3 Hellbenders, ...	5	R. W. Wehrle, Indiana.
9294	Common Garter Snake (Thamnophis sirtalis).	5	S. J. Fritch, Berwick.
9295	(a) Common Water Snake, ...	5	G. and J. Landis, McCulloch's Mills.
9296	Grass Snake (Liopeltis vernalis), ...	5	W. H. Schuckers, Reynoldsville.
9302	House Snake (Lampropeltis doliatus triangulus).	6	A. W. Smith, Blairsville.
9310	House Snake, ...	7	C. A. Benner, Farrandsville.
9313	(a) Common Garter Snake, ...	7	G. and J. Landis, McCulloch's Mills.
	(b) Common Water Snake, ...		
9322	Common Lizard (Sceloporus undulatus).	8	H. A. Brightbill, Marsh Run.
9323	(a) 6 Common Water Snakes, ...	8	G. and J. Landis, McCulloch's Mills.
	(b) 1 House Snake, ...		
9324	2 Hellbenders, ...	8	J. H. Hawkins, Harrisburg.
9333	Southern Lizard (Sphaerodactylus notatus Baird).	10	W. W. Climenson, Honey Brook.

SPECIMENS RECEIVED DURING JUNE, 1907—Continued.

Number.	Specimens.	Date—June, 1907.	Name and Address.
9337	(a) Blacksnake, ... (b) Common Water Snake, ...	10	G. and J. Landis, McCulloch's Mills.
9338	Spreckled Turtle (Clemmys guttatus).	10	G. R. Pritchard, Harrisburg.
9341	(a) Black Snake, ... (b) Newt, ... (c) Land Salamander (Plethodon cinereus).	10	I. H. Leibelsperger, Fleetwood.
9346	Common Water Snake, ...	11	W. O. G. West, Danville.
9347	Painted Turtle (Chrysemys picta).	11	C. L. Gruber, Kutztown.
9348	Common Water Snake, ...	11	A. Robertson, Sharon Hill.
9350	Blacksnake, ...	11	C. T. Cornman, Carlisle.
9351	Common Water Snake, ...	11	A. W. Smith, Blairsville.
9352	(a) Box Tortoise (Terrapene carolina). (b) Common Garter Snake, ...	11	R. W. Wehrle, Indiana.
9353	House Snake, ...	11	W. B. Summers, James Creek.
9372	Pilot Snake (Callopeltis obsoletus), ..	12	L. McDonough, West Brownsville.
9373	2 Hellbenders, ...	12	R. W. Wehrle, Indiana.
9374	2 Common Garter Snakes, ...	12	T. A. Berkey, Easton.
9375	Common Garter Snakes, ...	12	A. W. Smith, Blairsville.
9389	House Snake, ...	13	C. E. Cole, Siegfried.
9390	Pilot Snake, ...	13	R. W. Wehrle, Indiana.
9401	(a) Granite Salamander, ...	14	E. M. Mixer, Union City.
9404	Blacksnake, ...	14	A. C. Rutter, Perkasie.
9407	(a) Turtle (Kinosternon pennsylvanicum). (b) Striped Lizard (Eumences fasciatus). (c) Common Water Snake, ... (d) Queen Snake, ...	15	K. Geist, Covington, La.
9413	Pilot Snake, ...	17	E. F. Benfer, Winfield.
9414	Hellbender, ...	17	R. W. Wehrle, Indiana.
9418	2 Land Salamanders, ...	17	L. R. Donleay, Etters.
9419	House Snake, ...	17	E. D. Gardner, Easton.
9423	House Snake, ...	17	U. L. Moyer, Bally.
9424	House Snake, ...	17	W. H. Kretchman, Me.
9427	Queen Snake, ...	18	R. W. Wehrle, Indiana.
9438	(a) Common Water Snake, ... (b) Ring-necked Snake, ...	18	A. W. Smith, Blairsville.
9440	House Snake, ...	18	C. H. Richter, Bittinger.
9441	House Snake, ...	18	A. W. Smith, Blairsville.
9442	2 Pilot Snakes, ...	18	W. O. Sleep, Bushkill.
9458	Common Garter Snake, ...	18	E. A. Berkey, Easton.
9461	Newts, ...	19	L. I. Seamon, Cresson.
9464	(a) Box Tortoise, ... (b) Snapping Turtle (Chelydra serpentina).	19	D. M. Lehman, Essington.
9465	Pilot Snake, ...	19	Col. W. D. Dixon, St. Thomas.
9467	(a) House Snake, ... (b) Blowing Viper (Heterodon platirhinos). (c) Common Water Snake, ... (d) Ring-necked Snake, ... (e) 2 Varied Tree Frogs (Hyla vercicolor). (f) 2 Sculptured Turtles (Clemmys insculptus).	19	F. D. Keboch, Williamstown.
9476	Pilot Snake, ...	20	C. A. Palmer, Warfordsburg.
9477	Pilot Snake, ...	20	W. E. Benner, Vicksburg.
9478	Queen Snake, ...	20	R. W. Wehrle, Indiana.
9479	House Snake, ...	20	C. Auch, Williamsport.
9480	2 Pilot Snakes, ...	20	C. A. Benner, Farrandsville.
9482	Common Garter Snakes, ...	20	Dr. G. Free, Danville.
9483	(a) Pilot Snake, ... (b) Common Garter Snake, ...	20	A. W. Smith, Blairsville.
9498	(a) 2 Green Frogs (Rana clamitans)..	20	R. L. Jackson, McConnellsburg.
9496	2 Common Garter Snakes, ...	20	Fred. Ruof, Hummelstown.
9503	Rattlesnake, ...	21	Dr. H. G. Nickel, Johnstown.
9504	Common Garter Snake, ...	21	S. Anderson, Harrisburg.
9505	House Snake, ...	21	F. Ruof, Hummelstown.
9522	Pilot Snake, ...	22	J. Berrier, Andersonburg.
9523	Red Salamander, ...		
9524	Common Garter Snake, ...	22	J. Bohn, Onset.
9532	Coral Snake (Osceola elapsoidea), ...		K. Geist, Covington, La.
9535	(a) Rattlesnake, ... (b) Pilot Snake, ...	24	C. A. Benner, Farrandsville.
9536	2 Copperhead Snakes, ...	24	J. H. Wilson, Huntingdon.
9538	House Snake, ...	24	B. Long, Ashbourne.
9547	Grass Snake, ...	24	W. L. Mann, West Fairview.

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OUR MONTHLY CHAT WITH READERS.

Our reasons for publishing this month on the methods of making collections of insects are that this is the month of the opening of schools, and teachers may be desirous of interesting their pupils in making collections, either for school purposes or for private use.

Entomology as an avocation or mere fad is one of the most interesting and refreshing subjects, and every person is justified in having both a vocation, or pursuit, and an avocation, or means of recreation. Also, many persons are attempting to make collections of insects, but without systematic or reliable directions, and their results are not satisfactory. The many farmers' clubs, granges and alliances now meeting regularly in their halls in this State can well make collections of their insect foes and friends, and have them named by sending them to this office or by other means, and put them on exhibition that they may be studied and used as a basis of practical work in destroying those that are obnoxious and preserving those that are beneficial.

It must be acknowledged that Nature Study in the public schools has not moved forward in Pennsylvania as in any of her neighboring States. This is mostly for the reason that our naturalists and educators have not taken the active steps in promoting the study of nature in the elementary schools or in the public schools. If the advanced students in nature themselves take no interest in the subject for beginners, they can not expect other persons to do so. There is no doubt of the great ethical value of every branch of Nature Study, and we hope to give such assistance as is possible to teachers and parents who are willing to try to develop this subject.

Our justification in publishing again upon the subject of making collections of insects is found in the scores of letters which we have received from students and teachers in various parts of this State, asking if it be possible to republish in a single volume the directions for collecting and preserving insects, which were formerly issued from this office as parts of such discussion published in various issues of our Monthly Bulletins. We solicit correspondence, specimens and exchanges.

Address all communications to H. A. SURFACE, Economic Zoologist, Harrisburg, Pa.

HOW TO MAKE A COLLECTION OF INSECTS.

BY H. A. SURFACE, *Economic Zoologist of Pennsylvania.*

As this is the month of the opening of schools, and also the best time in the entire year for the study of certain specimens, it is appropriate for us to take this means of answering questions on how to make a collection of insects.

Collecting Insects vs. Birds.

In the first place, there are not the objections to collecting insects that can and should be made to collecting birds. Some of the reasons for this statement are as follows:

(1) Insects in their adult or winged form are very short lived, existing but long enough in this stage to perform the purposes of nature in reproducing their kind. When they are collected and preserved they have reached the limit of their period of natural existence upon the earth, and would soon die by natural consequences, if not preserved by the entomologist.

(2) Insects are much more numerous than birds and the extermination of a few or even of many specimens would not result in the perceptible reduction of creatures valuable to man, even though they should be beneficial insects.

(3) Insects multiply so rapidly that any reduction in their numbers would soon be regained and the loss of even a great many would not be noticeable in any one region. Whereas, birds multiply slowly, and the extermination of those found in any one region would mean the absence of birds from that locality for some length of time.

(4) The common insects are more likely to be injurious than beneficial, and all of the leaf-eating species may properly be called injurious insects. In destroying them one is conferring a favor upon mankind by saving his property, whereas birds are much more likely to be beneficial than injurious, and in destroying them the property of mankind would suffer loss through the increased destruction wrought by insects upon which birds would feed.

(5) Insects are so low in their organization that they do not suffer much, if any, pain when captured, and do not suffer from freight as do birds, which are among the most highly organized and sensitive creatures upon the earth.

(6) In killing insects there are no agonies of the death throe to be seen by the collector and to destroy the keener sympathetic features of his nature by making him coarse and brutal, as in killing birds.

(7) Insects are easily handled, the work with them is clean, and the training in deftness or skill for the fingers in properly pinning and spreading them is of great value.

(8) Insects are so varied in structures, habits, haunts, etc., and so numerous that they can be collected in sufficient numbers to illustrate nearly all of the important laws of nature in relation to biology or living things. A collection once made is never completed, but becomes a nucleous for the addition of further material. No collector in any country pretends to have nearly all the insects found in his own locality, although his collection may number tens of thousands. Not only are species new to the collector constantly occurring, but also many that are entirely new to science. These new forms may be found in any portion of our country by careful effort. The full life histories and natural enemies of very few, even of our common insects are known to mankind, and every time the entomological collector goes into the gardens, fields, orchards, woods, or along ponds or streams, he can see and learn something new. Nature thus becomes to him an open book with new pages turned every day.

Apparatus:

The person who wishes to make a collection should provide himself with certain necessary material. He should have small tin boxes in which to carry the leaves or other parts of plants containing feeding larvae, or immature insects. He should also carry a

Fig. 1.—Cyanide Bottle. Used for killing insects when collected. Original. Drawn by W. R. Walton in Office of Economic Zoologist.

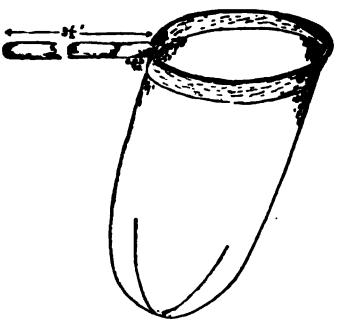


Fig. 2.—Net for collecting specimens in the Air. From Bulletin by Prof. E. P. Felt, State Entomologist of New York.

cyanide bottle for killing specimens he does not care to keep alive. He should also have several bottles of formalin or dilute alcohol, with labels on each. The cyanide bottle (shown in Fig. 1), is easily made by dropping a lump of cyanide of potassium the size of a small hickory nut into a large-mouthed bottle or jar, and covering it with plaster of Paris, then pouring on enough water to make it set, and standing it upside-down to drain and harden. After it is dry cover

the plaster with a sheet of blotting paper, cut just large enough to fit snugly the inside of the bottle, and crowd it in like a gun wad in the barrel of a gun. Keep this bottle corked tightly at all times except when it is necessary to open it, and as much as possible avoid breathing the fumes. All kinds of insects can be killed within a few minutes by dropping them into it. An excellent killing bottle can also be made by pouring a few drops of chloroform upon a small wad of cotton in an empty jar or bottle. For a person doing much field work, a killing jar, such as a pint fruit jar, will be found very useful.

The collector will also need a net, shown in Fig. 2, which may be made of a wire hoop a foot or more in diameter inserted into a handle like a cane, and covered with a bag of mosquito netting or cheese cloth about two feet deep. The patterns for this net are shown in Fig. 3. Either form makes a good bottom.

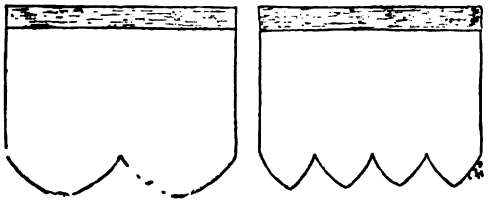


Fig 3.—Net Patterns. From Bulletin of N. Y. State Museum, by Prof. E. P. Felt.

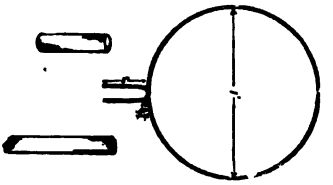


Fig. 4.—Plan of net frame and handle. From Bulletin of N. Y. State Museum by Prof. E. P. Felt.

Mosquito netting is too delicate for much use in collecting and the meshes are too large to hold very small specimens. The best material we have found is old silk bolting cloth from flour mills. Around most flour mills there may be found pieces of bolting cloth which have been rejected because very small holes in them have made them unfit for service. Such material is strong enough not only for nets for collecting in air but also for water nets.

A very serviceable plan of water net is our original design shown in Fig. 5, which consists of a small conical net with a small hoop around the bottom which should otherwise be left open and suspended in the larger net which is to hold the aquatic creatures. Both are attached to the same rim and the small net acts in the same capacity as the mouth of a fish basket. The collector will find this especially useful in capturing rapidly moving aquatic creatures.

He will also find an umbrella useful, not only to keep off the sun and rain, but also to open and hold upside-down under the branches of trees, while he beats them to jar off the insects they may support. Finally he needs a note book and pencil and some gummed labels. No naturalist has any business to exist without the means of promptly recording exactly what he sees.

Where to Collect:

Specimens may be collected in all kinds of places: In the water, in the air, in the soil, beneath stones, logs, bark, fallen leaves, animal droppings, in the stems and trunks of plants and trees, in and on leaves, on animals, and in the household, stores, mills, and other buildings. No place should be neglected, as the different haunts will yield species which have different natures and structures. It is extremely interesting to collect some insects from the water and see how perfectly they are adapted to aquatic life by the natural

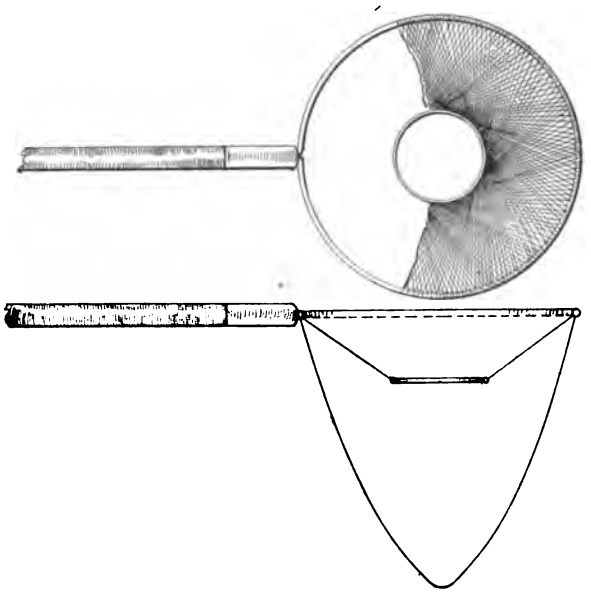


Fig. 5.—Water Net. Original design by H. A. Surface, Economic Zoologist. Original drawing by W. R. Walton, in Office of Economic Zoologist.

structures with which they are provided. Then note the adaptations of borers, diggers, climbers and flyers, etc., to their respective environments. The more varying the collection grounds the greater will be the number of specimens found and variations shown by them.

We find it very important to warn beginners or young collectors against the practice of taking long trips to collect specimens. A village garden presents as good a collecting ground as one will need, and there is no necessity nor is it advisable to wear oneself out by lengthy trips, losing time and specimens and in many cases ruining those collected by not taking care of them promptly. The collecting excursion should be conducted most leisurely. The collector should go to the region he wishes to investigate, equipped with bottles, net, umbrella or beating cloth, a strong knife, hatchet and trowel, make thorough investigations of the plants, decaying wood

and soil in that particular spot. When he goes collecting it should be for some definite purpose, to collect certain kinds of specimens that are known or supposed to be in some particular region, or to investigate some condition, phenomenon, or appearance of insects of certain kinds of plants. It is a good plan for young collectors to devote their attention on any one particular trip to insects injurious to one kind of plant, such as peach, apple, clover, grass or any other kind. Examination should be made of the leaves, fruit, twigs, trunk, bark and root, dissecting each when possible to see if it be tenanted. If immatured specimens be found they should be kept in breeding cages, on the natural food, to rear them to maturity.

Keeping Records:

It is not supposed that any one will know the names of all of his insects when he collects them, and this is not necessary, although it is essential for the collector to have some system by which he promptly keeps records of his specimens, and can make use of his notes at any time in the future for a proper study of the occurrence of the insects to which they refer. This is easily provided by a series of numbers. Give the same number to all specimens that were collected under the same conditions, i. e., at the same time, in the same locality, and on the same plant. As soon as the conditions change, as for example, in finding insects on another kind of plant, even in the same locality, give the second lot a new number. If one should change the collecting ground, as from swamp to a hillside, he should give different numbers to the insects collected in the different localities; and when he changes the date, even though going to the same place upon a subsequent expedition, he should give a new and distinguishing number to the material thus collected. There may be a great many different kinds of specimens thus bearing one number, but this number will show that they have all been collected under the same conditions. Each different kind represented by this number may be designated by a distinguishing letter added to the number, for each respective species or kind included under it.

Thus our collection No. 10414 is given to all specimens that were "Collected on the flowers of the Willow-leaved Milkweed (Asclepias incarnata) at Silver Springs, two miles north of Mechanicsburg, Pa., from 3 to 5 P. M., August 10, 1907, by H. A. Surface, Harrisburg, Pa. Weather bright, warm and sunny; light wind."

The different specimens are indicated as follows:

10414 a. Apis mellifica. Honey bee.
10414 b. Bombus affinis. Bumble bee No. 1.
10414 c. Bombus sp. Bumble bee No. 2.

10414 d. Pompilus sp. Digger wasp.
10414 e. Vespa sp. Yellow Jacket.
10414 f. Musca vomitoria. Blow fly.
10414 g. Diptera sp. 1. Unidentified fly No. 1.
10414 h. Diptera sp. 2. Unidentified fly No. 2.
10414 i. Diptera sp 3. Unidentified fly No. 3.
10414 j. Phymata erosa pennsylvanica. Ambush bug.
10414 k. Lygæid. Plant bug.
10414 l. Jassid. Leaf hopper.

In pinning them each species or kind collected under that number should be given its own distinguishing letter, as shown above. If it be found later that two or more species have been entered by error under the same letter it can easily be remedied by employing an unused letter for designating the specimens of the extra species. If so many kinds of species be collected at one time and put under one collecting number as to demand the use of all the letters of the alphabet the collector can either employ double or triple letters as "aa", "bb", or "aaa", "bbb", etc., or he can enter some of his collection under a new number, recording the same notes for it.

As all true scientific deductions are based on individual observations it is very important that these be recorded in a definite and systematic manner. The simplest way to make a record of what has been observed concerning any one individual insect is to use a small number following the letter used for the species attached to the collection number. Thus for example, in our collection No. 10414, the Bumble Bees of the species Bombus affinis are designated in our notes as 10414 b, which number and letter their labels bear; and among them were some individuals that were the basis of important scientific observations, and both the specimens and notes are indicated as follows: In this collection the individual Bumble Bees which called for personal notes or record are designated as 10414 b (1), 10414 b (2), 10414 b (3), and the notes concerning them show "specimen 10414 b (1) had so many pollen masses of Willow-leaved Milkweed attached to its legs that it did not try to fly but remained apparently clinging to the underside of the leaf of this plant." "No. 10414 b (2) was attacked by Assassin bug (Phymata, No. 10414 j), which tried to kill it but after one jump did not continue its attack." "No. 10414 b (3) was resting on the ground under the plant of Willow-leaved Milkweed with as many as five dozen stamen or pollen masses attached to one leg (See specimen)." Those individual specimens that are of such special interest as to justify notes concerning them should be collected and preserved in a separate bottle or box at the time of their collection, to prevent losing them or confusing them with others.

In the field note-book one should record every possible fact under the respective collection numbers, and if he afterward obtain the names of his insects, he may add these to the field notes, if he should choose. The one requirement above all else in the label of the specimens is not the name, but the number referring to the collecting note-book, thus giving in as great detail as possible the facts which were written at the time the specimen was collected. To keep specimens separated, which have different numbers it is important to have a number of empty bottles or small boxes into which the specimens may be transferred after they have been killed in the cyanide bottle, putting into each bottle or box only those which should be given one particular number or letter, and putting upon and also in the bottle or box the number and letter referring to the collection of the material it contains.

What to Collect:

In collecting specimens, some may be kept alive for study of their food, habits, eggs, larvæ, parasites, etc., and if immature or young specimens be collected some of them should be kept alive in order to obtain the adult or mature insects. Almost all descriptions and analytic tables or keys for determination are based on the adult forms. All insects with wings are "full grown" or mature. They never (excepting Mayflies) molt again nor grow larger after having attained the winged form. The little winged flies are not the young of larger individuals, nor are small beetles the "young ones" of larger beetles. Each represents a distinct species, and if all the species or kinds in a region are desired, the different sizes should be collected in order to obtain the different kinds.

Directions for collecting have been given in detail by Dr. C. V. Riley in a Bulletin of the United States National Museum, but as it is not available for many readers who have written to us for such corrections, we here quote some paragraphs freely from it.

Killing Specimens:

Specimens not intended for rearing should be killed immediately after capture, unless for each living specimen a separate vial or box can be provided. If a number of miscellaneous insects are put alive in the same vial, the stronger specimens will, in a short time, crush or otherwise injure the more delicate ones, or the predaceous species will devour any others they can master. But even where the specimens are killed immediately, the following rule should be observed: Do not put large and small specimens in the same vial, but provide a larger bottle for the larger specimens, and one, or still better, several smaller vials for the medium sized and very small specimens. The importance of this rule is recognized by all experienced collectors.

All insects in the mature form may be killed by dropping them into the cyanide bottle, but owing to the fact that the large, coarse insects, like the beetles, are likely to injure the delicate insects, like the moths, when put in the same bottle, expecially while the former are alive, it is best to have two or more cyanide bottles, and assort the insects in such a way as to keep them from injuring one another.

All insects in the immature or young stage, whether it be the egg, larva, nypmh or pupa, can be killed by putting them into dilute formalin or alcohol. The formalin should be about 5 per cent. strength and the alcohol about 50 per cent. strength.

Specimens from one kind of plant only, or deserving the same number, should be put into the same bottle. The collecting number referring to detailed notes upon them should be written on a slip of paper with pencil and put into the bottle at the time of making the collection, and also be written on the gummed label on the outside of the bottles. It is much more important to put a label in the liquid in the bottle than to write it on the outside where it may be lost and the collection can no longer be identified.

Of each of the immature stages there should be enough specimens collected to keep several alive in the breeding cages for the purpose of securing both sexes of the adult or mature form, and also to collect and preserve a few in each of the other stages as they progress in their course of metamorphosis.

In collecting the living insects a generous portion of the food plant should be collected with them and preserved in a tin or metal box until the return to the breeding cages. The specimens should be established at once in a glass vessel where they can be covered with cheese cloth and preserved with natural food and kept until they reach their maturity. It is very important to have some specimens of each of the immature stages to be preserved in liquid or by blowing.

There are several methods of killing insects, each having its own peculiar advantages and drawbacks.

Alcohol.—The use of alcohol will, on the whole, prove the most satisfactory method of killing Coleoptera or Beetles, many Hemiptera or Bugs, some Neuroptera, and larvæ of all sorts. Only the best quality of alcohol should be used, but it should be diluted with from 30 to 40 per cent. of pure water, the greatest care being taken to keep the alcohol as clean as possible. During the collecting a mass of debris and dirt is apt to be thrown into the bottle, and when this is the case the alcohol should be changed even during short excursions. At any rate, upon the return from the excursion, the specimens should be at once taken from the bottle and washed in pure alcohol in a shallow vessel. The larvæ and other material intended

for permanent preservation in alcohol should be transferred to suitable vials and the other material to be mounted cleansed with chloroform or acetic ether and then prepared for the cabinet. If inconvenient or impossible to mount the Coleoptera, etc., soon after the return from the excursion they should be washed, dried, and placed in pill boxes between layers of soft paper, or they may be replaced in a vial with pure alcohol.

Small specimens, especially larvæ, may be preserved in small bottles of alcohol if they be tightly corked. In order to permit the

Fig. 6.—Bottle of Alcoholic Specimen with Rubber Stopper, showing how a pin is used to let the air out of the bottle so the cork will fit tightly. From Bulletin of N. Y. State Museum, by Prof. E. P. Felt.

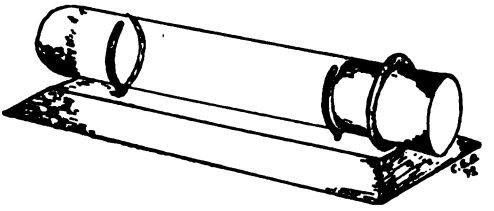


Fig. 7.—Board and clasps for holding bottle of alcoholic specimens placed horizontally. From Bulletin of N. Y. State Museum, by Prof. E. P. Felt.

air to escape from such bottles, and insert the cork tightly, a pin may be held between the side of the cork and bottle, as shown in Fig. 6. These bottles may be kept either in frames, racks, or in boards with holes bored in them to receive the bottles and hold them upright, or they may be fastened on their sides by little blocks, and

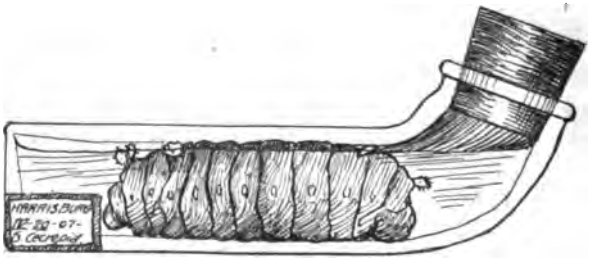


Fig. 8.—Bottle with up-turned mouth and flat side for holding specimens horizontally. Drawn by W. R. Walton in Office of Economic Zoologist.

kept in the cabinet in their proper places with other insects. Fig. 7 shows a device for holding such bottles of alcoholic specimens.

Figure 9 shows a compact form of bottle rack which is our own device for holding small bottles of specimens in liquid. It consists of a long narrow block of wood with a groove of the desired depth and width cut in the upper side. Into this groove the bottles stand and are held in place at the ends of the block by pieces of heavy paper glued over the ends. These blocks are pushed endwise into the shelves, and the numbers or names on the labels on the end shows what collection they contain.

Killing with the fumes of chloroform or ether (sulfuric or acetic), of benzine, or some other etheric oil, is often practiced and advocated by those who, for any reason, dislike the use of alcohol or object, on account of its poisonous nature, to the use of cyanide of potassium, and they are of especial value in the case of butterflies and moths, Hymenoptera or Bees and Wasps, and Diptera or Flies.

A small and stout bottle of chloroform or ether, with a brush securely inserted into the cork, will be found very serviceable. A slight

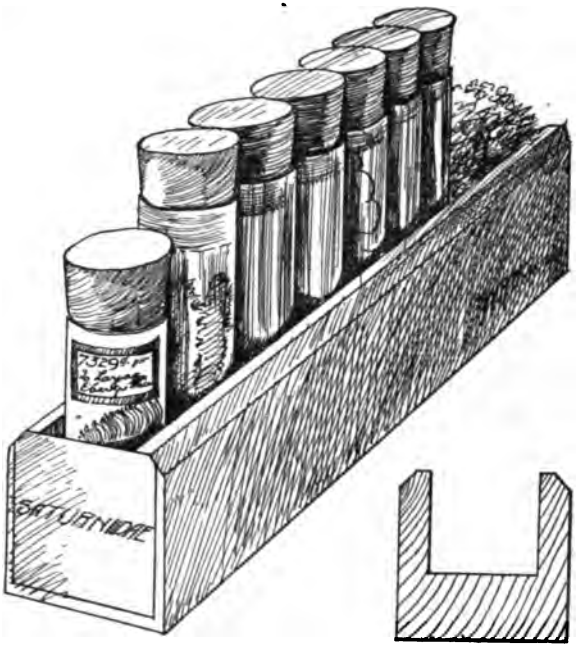


Fig. 9.—Bottle rack made of grooved block of wood. In use in collection of the Economic Zoologist. Drawn by W. R. Walton in Office of Economic Zoologist.

moistening through the air net will stupefy most insects caught in it, and facilitate their removal to the cyanide bottle; while a touch or two with the wet brush under the head and thorax, will kill the more delicate specimens outright, without in the least injuring them.

The method of killing which, of late years, has found most favor with collectors, is the use of cyanide of potassium. For killing large sized specimens they are simply put in what is known universally as the "cyanide bottle." This may be constructed as follows:

Take a two-ounce quinine bottle, or still better a shorter bottle, with a wide mouth; break a quantity of cyanide of potassium into pieces of convenient size (about a cubic centimeter); put these pieces into the bottle so that they form an even layer at the bottom; mix in

a convenient vessel a quantity of plaster of Paris with water just sufficient to make the mixture semi-fluid and then pour it over the cyanide so as to cover this last to a depth of about 5 millimeters. The bottle is then left open for an hour or two until the plaster is thoroughly dry. The walls of the bottle are then cleansed from particles of the plaster which may have splashed on them, and the bottle is ready for use. (See Fig. 1.) If not used too frequently, especially in warm weather, it will last for an entire year or longer. Bottles or vials of different sizes can be prepared in the same way, and a very small cyanide bottle which can be carried in the vest pocket will be found most convenient on all occasions. When the collected specimens have been removed from the bottle the latter should be wiped clean with a piece of cloth or paper. The surface of the plaster soon becomes dirty and, on account of the hygroscopic property of the cyanide, more or less moist, especially during warm weather. The cyanide bottle is, therefore, not well adapted for the killing and temporary preservation of small and delicate specimens. This difficulty can be altogether obviated by placing a circular piece of blotting paper, cut to fit neatly the interior of the bottle, on the surface of the plaster. This can be removed once a week or so, or oftener if it becomes necessary. It will frequently be advisable, also, especially in the collection of Diptera or Flies, Hymenoptera or Bees and Wasps, and other delicate insects, to put a strip of blotting paper partially round the inside of the bottle. This will absorb any moisture which may gather on the inside of the bottle and which would otherwise wet and injure the specimens. A similar result is attained by some collectors by partially filling the bottle with narrow strips of soft or absorbent paper to support and separate the insects.

We have found the use of benzine or gasoline very cheap and satisfactory for killing Lepidotera or Moths and Butterflies, as the largest are at once killed thereby without injury to their scales. Squirt it onto the specimen within the net or in the open air by means of a druggist's dropping tube.

Care of Fresh Specimens.

Upon the return from an excursion the specimens should be prepared for the collection as soon as practicable. If they have been collected in the forenoon they should be mounted not later than the same evening and those collected during an afternoon or evening excursion should be mounted the following morning, or, at any rate, before they get dry and brittle. Even specimens collected in alcohol should be attended to as soon as possible.

Specimens are taken from the collecting bottle, spread out on a sheet of white blotting paper and cleaned from adhering impurities

either with a soft dry brush or, in the case of species with hard covering, by washing them with chloroform, or ether, or benzine where necessary. Theoretically, the best way of mounting would be to pin all specimens, since the under side with its important characters then remains free for examination. Pins adapted for pinning even the smallest insects may be obtained, but this pinning is such a delicate operation and requires so much time that, considering the large number of small specimens that may be collected on a single short excursion, it is next to impossible to carry out this method, and, therefore, only the larger specimens need be pinned and the smaller may be glued onto the paper points described later. If the work is done with proper care all insects can be prepared for the cabinet so that both the upper and the under surface of the specimen may be examined without further manipulation.

Dr. Riley writes: "Many English entomologists use short pins, very much like those of ordinary make, and my late friend Walsh never gave up the custom, and most vehemently opposed the use of what he ridiculed as 'long German skewers.' But the only advantage that can possibly be obtained for the short pins is that they are less apt to bend, consequently more easily stuck into the bottom of boxes and require less room; while compared with the long pins, they have numerous disadvantages. Long pins admit of the very important advantage of attaching notes and labels to the specimen and render it more secure from injury when handled, and from museum pests in the cabinet, and on them several rows of carded duplicates may be fastened, one under the other, so as to economize room."

Pinning Specimens:

In pinning insects one should use regular insect pins, such as are shown in Fig. 10. These may be obtained from dealers in such supplies (such as Arthur H. Thomas, Williams, Brown and Earle, Philadelphia and Kny-Scheerer Co., New York City.) While regular insect pins are not essential in an amateur's collection, they add greatly to its attractive appearance and give more room for labels, but in making exchanges of pinned specimens it is practically necessary for them to be pinned on regulation pins. The pins should be pushed through the insect far enough to leave but one centimeter (slightly less than one-half inch) of its length above the back of the insect. Collections should be made neat and attractive by having the backs or tops of all specimens at the same level. This is best accomplished by the use of a pinning block or pinning gauge (Fig. 11) for the placing them at the proper position on the pin at the time of pinning. This block, which is very con-

venient to use, consists of a small plain block of wood of thickness equal to the desired height from the back of the specimen to the top of the pin, with a hole through which the pin is pushed to the desired position, after putting it through the specimen and turning it upside down, using the thickness of the block as the desired gauge. However, we mostly use as a gauge a bent pin inserted in a handle, as shown in Fig. 12.

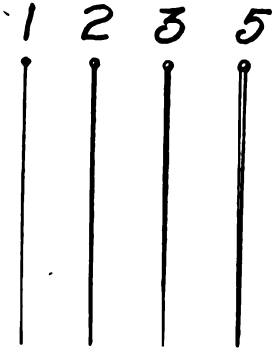


Fig. 10.—Insect pins of different sizes. No. 3 is best for small specimens and No. 5 for large. Drawn by W. R. Walton in Office of Economic Zoologist.

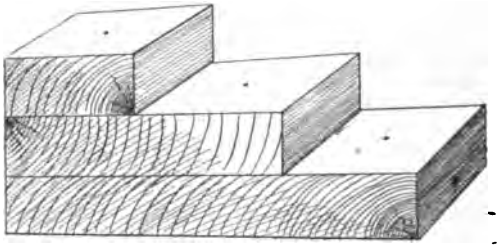


Fig. 11.—Pinning Block. Used as a gauge for pinning specimens. Drawn by W. R. Walton in Office of Economic Zoologist.

Insects should be pinned through the middle of the thorax, when, as is more generally the case, this portion (the mesa-thorax) is largely developed. However, beetles (Coleoptera) (Fig. 13 g) should be pinned through the right elytron or wing-cover, and bugs (Hemiptera) (Fig. 13 b) should be pinned through the scutel, or triangular piece behind

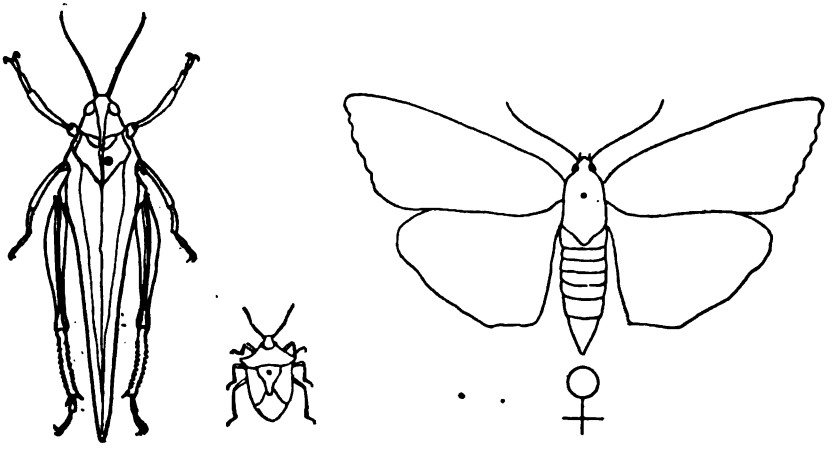
Fig. 12.—Pinning Gauge used for measuring proper height of insects on pins. Drawn by W. R. Walton in Office of Economic Zoologist.

developed. However, beetles (Coleoptera) (Figs. 13 f and g) should be pinned through the right elytron or wing-cover, and bugs (Hemiptera, (Fig. 13 b) should be pinned through the scutel, or triangular piece behind the thorax, the pin issuing between the middle and hind legs. The specimens look very pretty with all the legs neatly spread out, but for practical purposes it is better to let them dry in the natural, partly bent position. It is a saving of time and space, and the legs are not so apt to break. The legs must also not reach too far downward or they will interfere with the proper labeling and

the secure pinning of the specimen in the cabinet. Moreover, the antennae and legs must be brought into such position that they will not obstruct the view of any important part of the under surface and can plainly be seen. The pin should always project about half an inch above the insect to facilitate handling, and uniformity in this regard will have much to do with the neat appearance of the collection. In pinning very large and heavy insects on a No. 4 or No. 5 pin it is a good plan first to flatten the pin by a few blows of a hammar, in order to prevent the specimen from subsequently turning round on it.

Entomologists in this country uniformly pin their specimens on long insect pins, as shown in Fig. 10. Nos. 2 and 5 are the best pins

Fig. 13.—Insects of different orders showing where pin should be inserted:



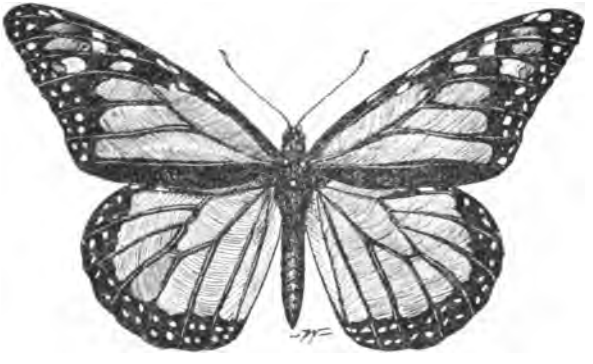
a. Grass Hopper. b. Pentatomid. c. Moth, Female.

for general use by beginners. The former are used for specimens of small and medium size, and the latter for large insects.

"In pinning specimens which have a flat or nearly flat under-surface and short legs (as in many Coleoptera and Hemiptera and some Hymenoptera, e. g., the Sawflies), the specimens are laid on a piece of cork, and held in place there with the fingers or with forceps. The pin is then pushed through the insect at the proper point, care being taken not to strike one of the legs or coxae and that the pin passes through the specimen in a vertical direction.

After the pin has been pushed through the specimen it is taken out of the cork and the specimen is pushed up to its proper height. This can be done either by holding the specimen between the fingers or by placing it on the upper edge of a thick book.. A piece of cardboard provided with a small hole may also be used for this purpose. The perforations in ordinary sheet-cork, or the lapel of one's coat,

will answer the same purpose. In pinning Lepidoptera or Hymenoptera (Figs. c d and i) the specimen should lie lightly in the angle formed by the thumb and first two fingers of the left hand and the pin be carefully thrust through at the proper angle. In pinning all

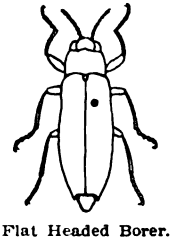


d, Butterfly.

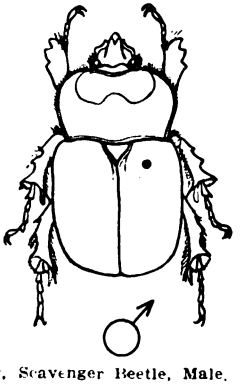
e, Leaf Beetle.

insects the pin should be so inserted that the insect is nearly at right angles to it."

The correct method of pinning specimens belonging to other orders than those sketched above is shown in Figs. 13 h and 13 i. The former of these represents the Flies, or Diptera, and the latter the Bees, or Hymenoptera.



f, Flat Headed Borer.

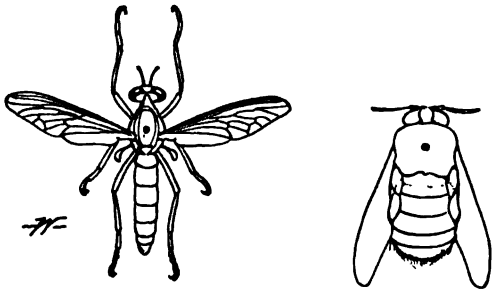


g, Scavenger Beetle, Male.

There are various ways of mounting very small insects, especially those that are too small to be pinned by putting a pin through them.

"One of the easiest ways of caring for minute specimens is to mount them on card points, which are triangular pieces of card, cut either with scissors or with a punch designed for the purpose.

An insect pin is thrust through the base of the card point and the specimen attached to its extremity with a little shellac, or gum. (Fig. 14. Or a fine pin may be taken, its head removed, the pin bent to a right angle, the larger end twisted with pliers tightly around a stouter pin near its point and pushed farther up on the supporting pin, and the specimen impaled on the upturned point of a smaller



h, Robber Fly. i, Bumble Bee.

pin. (Fig. 14 b.) Another way of accomplishing the same end is by cutting off the larger portion of the smaller pin and thrusting the point through a piece of cardboard or firm blotting paper (or cork), which, in turn, is mounted in a similar manner on a larger pin, and is then ready for the insect. (Fig. 14, between b and c.) Small species can also be put with labels in gelatine capsules, through one

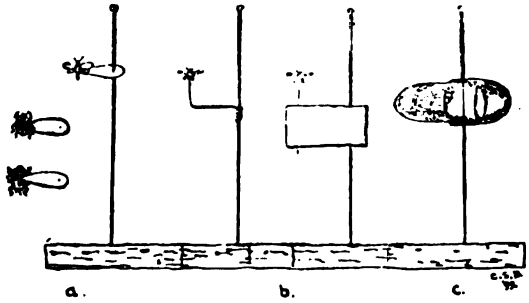


Fig. 14.—Illustrations of various methods of pinning and preserving very small insects. Paper point shown at the left. Gelatine capsule shown at the right. From Bulletin of N. Y. State Museum, by Prof. E. P. Felt.

end of which a pin is run." (Fig. 14, c).—(Prof. E. P. Felt, State Entomologist, in Bulletin of the New York State Museum). Very small specimens can also be nicely preserved, dry, by putting them into small vials and with an insect pin through the cork of each; pin it just as though the little bottle were a large insect.

Storing, Packing and Shipping Specimens:

It is often desirable to store specimens in compact space or to ship them by mail in a manner in which they will not be broken easily, as when packed. For these purposes, folded papers are to be used. Especially moths and butterflies, which are delicate and easily broken when shipped with the wings spread, may be sent by mail without injury when plaeed in folded papers. Fig. 15 shows the method of folding papers to make envelopes or covers into which such specimens may be dropped, and the ends turned over for protection and keeping them in place. On the paper write the number, date and locality of collection and such other data as can be given. Where delicate specimens of moths and butterflies are to be sent to this office by mail, this is by far the best way of treating them. Even

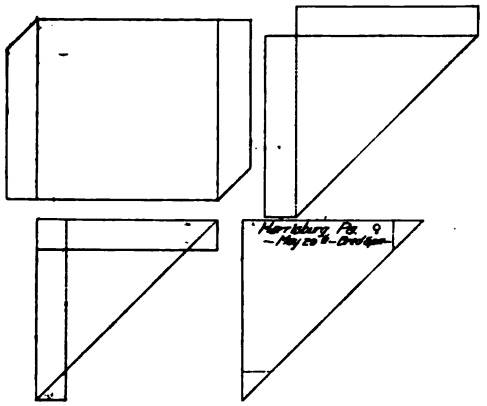


Fig. 15.—Folding Papers. Illustrating method of folding and shapes of papers for packing large winged insects. Drawn by W. R. Walton in Office of Economic Zoologist.

though they become entirely dry, they may be relaxed and spread at any time afterward in such a way as to become first-class cabinet material.

Spreading Specimens:

The wings of many kinds of insects should be spread before they are fit for the cabinet. This is especially true of butterflies and moths. It is best to spread them soon after they are killed and before they commence to become dry and stiff.

The legs and antennæ, or "feelers," should be properly set or put in the desired position, and if the insects be moths or butterflies, the wings should be spread or "set." This is done by using a setting board, (Fig. 16) which is made by nailing end strips under two pieces or boards of soft wood far enough apart to let the body of the insect sink into the groove between them. Beneath these two boards tack a strip of corrugated paper, cork, pith or blotting paper

PLATE XVI.—A Case Showing a Systematic Collection of Insects, Showing Representatives of all Orders and Many Families of Pennsylvania Species.

Collected, Prepared and Photographed in the Office of the Economic Zoologist of Pa.

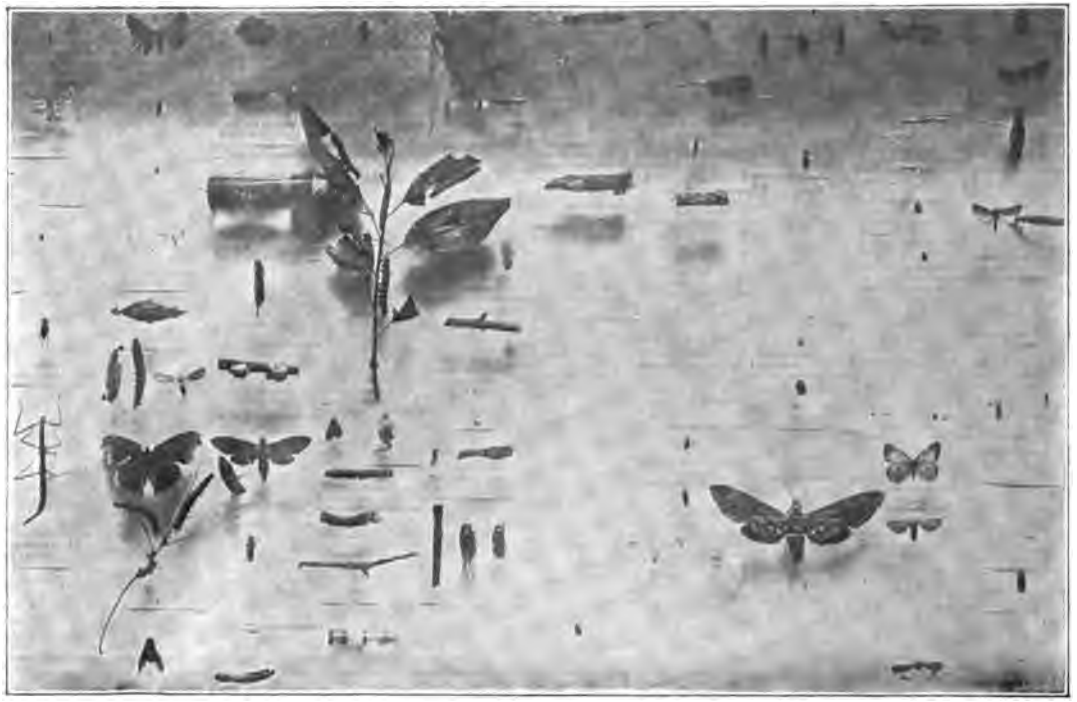


PLATE XVII.—A Case Containing an Economic Collection of Insects, Showing Many Injurious Pennsylvania Species, with the Food of Some.

Collected, Prepared and Photographed in the Office of the Economic Zoologist of Pa.

to receive the pin bearing the insect. Pin it down until the body sinks into the groove between the boards, and then spread the front wings until the hinder edges or margins make a straight line across the body at right angles to it. (See position in Fig. 18.) Fasten the wings in position by strips of paper or ruled tracing cloth pinned over them to hold them down, and put the setting board aside, so that the specimens can dry for a week or more, and become firmly fixed in the positions in which they were left. We have found ruled tracing cloth to be the most satisfactory material for holding wings in position on setting boards while drying. The tracing cloth is

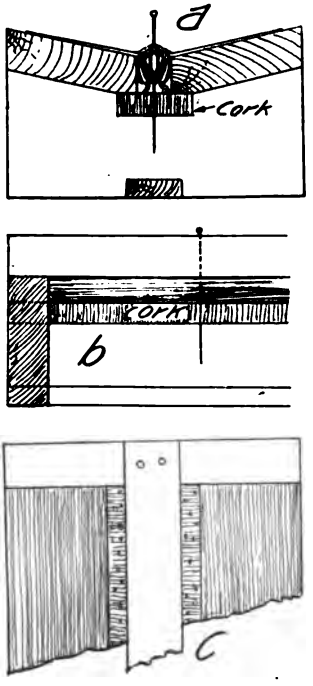


Fig. 16, a, b and c.—Spreading Board, showing method of construction. Drawn by W. R. Walton in Office of Economic Zoologist.

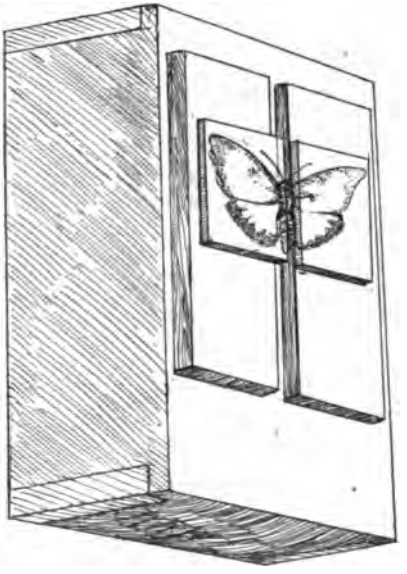


Fig. 17.--Paper box used for spreading insects, especially small moths. Drawn by W. R. Walton in Office of Economic Zoologist.

transparent enough to permit the position of the wings to be seen plainly, and the lines make it easy to set them at exact right angles (See Fig. 18).

"Another method of spreading requires still less material. The pin sustaining the insect is thrust through the pasteboard bottom of a small inverted box and squares of pasteboard, or thin wood of ample size, are laid on either side in such a manner as to be of the proper height. With a needle arrange the wings on the squares of pasteboard so far as possible and hold them in place by laying on

small pieces of glass. By tipping up one edge of the glass considerable rearrangement is possible, or by pushing the lower block gently, wings and all may be moved either forward or backward. This method is capable of producing good results, but the setting board is preferred by many. In spreading butterflies and moths the greatest care must be exercised not to rub off their scales. Members of the bee and wasp family, dragon flies and the others are more valuable after spreading and should be so treated when possible."—(Prof. Felt, in Bulletin of the New York State Museum.)

When insects are pinned, properly spread and thoroughly dried, put them for temporary storage into cigar boxes lined with corrugated paper or cork, or into tightly covered cases, and keep them away from dust and pests.

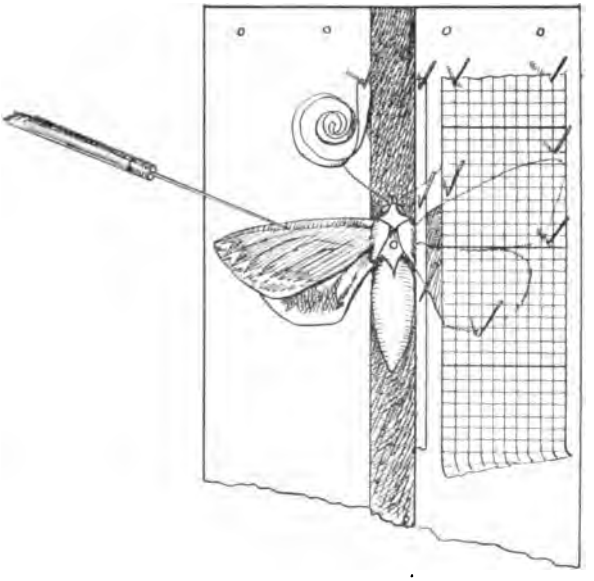


Fig. 18.—Spreading Board showing wings of moth under tracing cloth. Original design. Drawn by W. R. Walton in Office of Economic Zoologist.

Blowing Larvae: Small insect larvæ may be preserved nicely by putting them into a liquid composed of one part commercial formalin, 49 parts of grain alcohol and 50 parts water. This will keep them in good form without hardening and will also preserve their color as well as any liquid that can be used.

The larvæ can be preserved and pinned with the collection of mounted specimens by blowing them and drying them while they are inflated. This is done as follows: After the larva is killed, roll it gently with a pencil rolled with slight pressure from head to rear until the alimentary canal protrudes behind. Cut this off with

scissors a short distance back of the body. Lay it on a sheet of blotting paper and by gently pressing it from head to rear press out the liquids and body contents. Change it to a dry part of the blotting paper as often as necessary to keep it clean and dry, and remove its contents by rolling it gently with a lead pencil from head to rear.

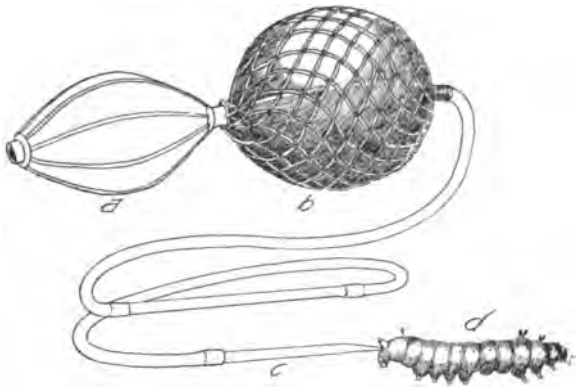


Fig. 19.—Inflating Apparatus for inflating larva. Original. Drawn by W. R. Walton in Office of Economic Zoologist.

By slight pressure (but not enough to crush it) it can be rolled so that nearly all of the contents are removed from the body, but the pigment under the skin, causing the characteristic spots and dots, and also the hairs covering it, need not be removed or destroyed. A little practice will render any collector quite proficient in this.

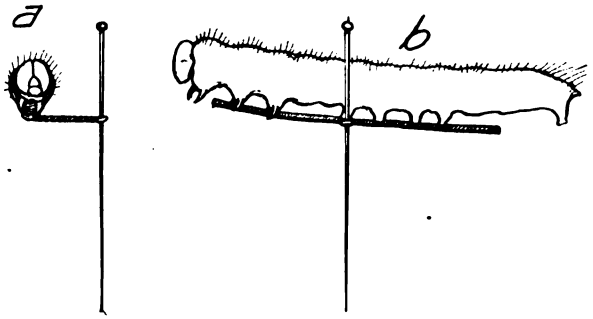


Fig. 20.—Inflated larva, dried and pinned. Drawn by W. R. Walton in Office of Economic Zoologist.

To blow it insert a small straw or quill in the posterior extremity and tie a thread tightly around it in such a manner as to prevent the larva slipping off the end of the straw. The best apparatus (Fig. 19) for blowing consists of a thin rubber bag connected by a short tube at one side with an air bulb for pumping the air into the

bag, and having on the other side a small tube which is to be slipped over the straw carrying the larva. By this rubber air bag a constant, steady pressure is maintained which will keep the larva inflated at a uniform condition until it is dry as will be discerned at once.

Inflating apparatus can be purchased from Arthur H. Thomas Co., Twelfth and Walnut Streets, Philadelphia, Pa., and the Kny-Scheerer Co., Fourth Avenue, New York City. However, if the collector can not afford the inflating apparatus he can use the straw, either held directly in the mouth or attached to a blow pipe. The process of blowing a larva is exactly like that of the blow pipe in maintaining a steady pressure, as in the blow pipe analysis. Any high school teacher of chemistry, geology or physics should be able to show how to blow a constant steady pressure through a small pipe for many minutes at a time and breathe without any inconvenience during the time.

The next step is to make a small drying oven by suspending on its side, over a flame, such as an ordinary lamp, a tin can, like an ordinary fruit can from which the one end has been removed. The larva, rolled fairly dry and clean and tied to the inflating straw. should be blown until it is distended to its normal size and then held in the drying oven and turned over and over to promote uniform drying, until it becomes dry and hard and does not "wilt down" when the pressure is removed. The drying should then be continued until the operator is certain that the specimen is entirely dry in all its parts. It can then be poisoned by spraying with alcoholic corrosive sublimate solution, and the end of the straw sticking into the body should be cut off a quarter of an inch from the specimen. The pin to hold it in the cabinet can be inserted through the straw (Fig. 20). The larva can then be pinned in the case beside the mature specimens of the same species.

Relaxing Dried Specimens: All work for adjusting specimens to desired heights, putting legs, wings, antennæ, abdomens (as of wasps), etc., in the desired position should be done while the specimens are soft and pliable or relaxed, as they are more brittle than glass when dry, and should not be handled or touched for any purpose whatever.

In preserving specimens that were preserved dry (i. e. not in liquid) when collected it is best to pin them as soon as possible after being collected; yet most kinds of mature insects can be kept dry and unpinned by putting them in a dry box, free from pests, providing they are not touched or shaken when dry, as they are then so easily broken.

After specimens have been collected and preserved in folded papers, as described in a previous part of this article, it is desirable

to relax them or soften them and spread them when time is to be found for such work. The relaxing or softening is easily accomplished by putting the specimens on damp sand in a closed jar or metal box or vessel and keeping it closed for a day or two. We have had excellent results in using glass cylinder jars, such as battery jars, lining the bottom and sides with a large sheet of blotting paper moist with water, and adding a few drops of carbolic acid to prevent molding of specimens. When the insects become sufficiently moist and soft that their wings and other appendages are easily put into place they may be pinned and spread on the setting board, just as in treating fresh specimens. The numbers referring to their collection should be kept with them at all times in order to avoid any error as to their origin.

Naming Specimens: The name is about the last feature of the specimen that receives attention excepting proper protection from pests. To name and classify specimens properly requires some knowledge of the terms used in classification and the use of analytic and descriptive literature, or access to named collections. The proper method for a young entomologist is to classify his specimens first to the great groups or orders, and second to the lesser groups or families by using some book for this purpose, such as Comstock's "Manual of Insects," and special literature on each group.

He should become sufficiently familiar with his specimens to be able to name the order and the family of any new species at once. To obtain the scientific name is a much greater difficulty. Descriptive literature or illustrations will be useful for this, or the specimens may be compared with named collections, or they may be sent to specialists for naming. In sending specimens to specialists it is best to send at least two of each kind bearing the same number and in good condition, giving him privilege to keep one set, or such as he may desire, for his trouble in naming them. Of course, if the collector is certain that the species are duplicated he can retain one set in his own collection and by giving the same numbers to those which he sends away the specialist can send him the names by referring to his numbers, but this method is not recommended for the reason that none but the specialist can be sure that any two specimens do or do not belong to the same identical species. The numbers used may be the collection numbers, which should always give the exact localities and dates of collection, with the name of collector. These facts are more important to the scientists than is the scientific name, for the reason that the latter name may be obtained by any one who knows the subject, but the desired facts as to the origin of specimens are to be obtained only by the record of the collector. Specimens sent to this office will be named upon terms indicated

above and retained in our Museum collection, but care should be taken to ship them so they will not be broken and time should be permitted for making the identifications. Other specimens will be sent in exchange if desired.

Writing and Placing Labels. All labels should be written with India ink or carbon ink. This is to avoid difficulty in the future from the fading or blotting of writing. One of our best friends and most enthusiastic collectors has recently written, "For two months I have been working hard, having been compelled to relabel my entire collection of birds and mammals, the ink having faded out, so as to have rendered the classification in almost every case unintelligible to the unacquainted." Even for specimens in liquids the carbon ink can be used without blurring by letting the writing become entirely dry before immersing it in the liquid. When this ink becomes thick dilute it with a little ammonia in water.

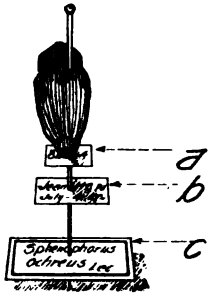


Fig. 21.—Manner of placing Labels, a, for Accession Number; b, for Locality and Date; c, for Scientific Name. Drawn by W. R. Walton in Office of Economic Zoologist.

The most important facts to record concerning the specimen are the date and locality of its collection, and the name of the collector. These may be written on a small label and pinned beneath the specimen, and upon the same label or upon a smaller one may be written the collector's accession number or the number that he uses to record the respective additions to his collection. The pin may also be put through this label, and when the name (genus and species and author) of the specimen is determined, this should be written on a separate label which can be held to the bottom of the cabinet, box or tray by the pin extending through it.

The specimens should be arranged in groups according to their respective orders and families, and the names of these groups should be written on larger labels, which should be placed in such a way as to indicate the limits of proper group. It is very important for

each beginner to see a collection arranged in the correct manner and observe the method of keeping data and placing labels. This varies with different persons, but every collector of natural history material of any kind should bear in mind that the most important facts to record permanently and keep with each specimen are those concerning its time and place of collection and the name and address of the collector. These are essential in making a study of the specimen in its relation to other creatures and to man, and only the one who collected it can give the necessary information. The name is not so important for the reason that this is not difficult to obtain at any time in the future, and a specimen without the scientific name may be of great value if it have the facts concerning its origin, but if these facts be not given it is generally absolutely worthless, even though the scientific name and classification may be correctly written. We recently went to see a large collection of mounted birds which the owner wished to sell, but as there were no records whatever, showing where and when they were collected, they were considered worthless for scientific purposes and no offer was made for them.

The exact date of the occurrence of an insect is particularly valuable for the reason that insects, like flowers, have certain dates when they appear and disappear, or change from one form to another, and the farmer and Economic Zoologist as well as the scientific collector are compelled to act in accordance with these dates. Beginners must not ignore the importance of keeping exact records of dates and localities when and where specimens were obtained.

Storing Specimens. The beginner will find old cigar boxes (Fig. 22) lined with pith, cork, or cork linoleum excellent for storing specimens and keeping them safe from pests. The museum pests that would otherwise attack them are deterred by the odor of the boxes and the specimens are thus kept uninjured for a long time. It is possible to use cases of nicer appearance and keep out museum pests by pinning among the specimens naptha balls into which hot pins have been sunken to support them in the cases. It is desirable that storage boxes be made as tight as possible and tongued and grooved, so that it will be impossible for pests to enter them and injure the specimens. There are several dealers in entomological supplies who sell glass-covered cases for insects at reasonable prices.

The best and most experienced collectors realize the necessity of protecting their specimens from injury by moths and beetles, to the extent that they take the trouble to poison them by spraying both the upper and under sides with an alcoholic solution of corrosive sublimate. A hand atomizer is used for this and the poison is dissolved in the alcohol and tested by dipping a black feather into

it. If upon drying, any white powder is seen upon the feather, more alcohol is added until the solution is of such strength that it is well saturated but will not leave a white deposit. This poisoned alcohol is then blown by the atomizer in a fine mist both over and under the specimens. We have known beautiful specimens kept many years in exposed situations after having been thus poisoned while on the other hand we have recently received several complaints of the destruction of cabinet insects by the museum pests. When these pests once enter a collection their presence becomes

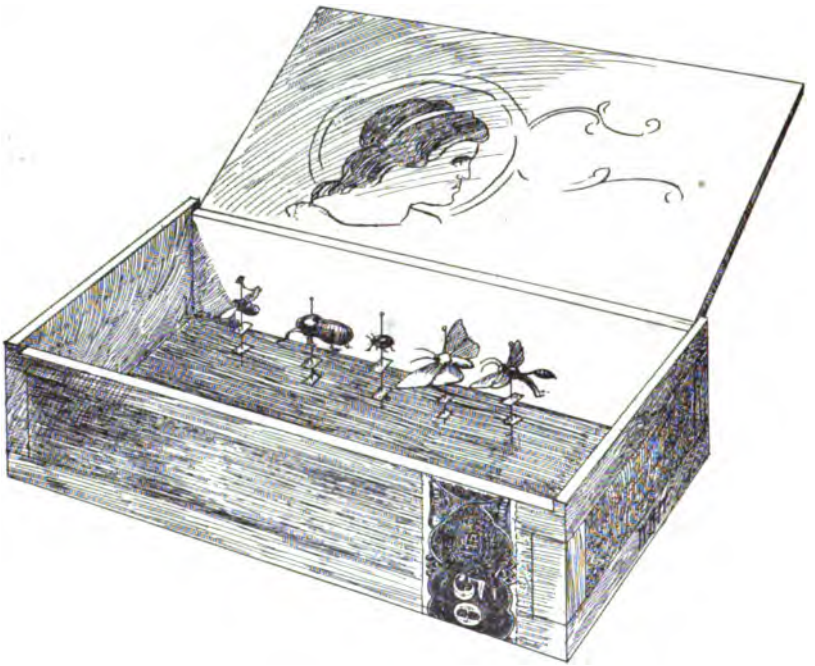


Fig. 22.—Specimens stored in Cigar Box. Drawn by W. R. Walton in Office of Economic Zoologist.

visible by a fine dust or powder beneath the specimens in which they are working. The infested specimens should be placed in a closed vessel and strongly fumigated with carbon bisulphide, or baked in an oven at a temperature that will not quite make wood smoke.

As all specimens are sure to fade if kept in a bright light, their cases should be provided with doors or curtains that will close and keep them darkened when not in use.

Individuals interested in entomology are invited to come and see our collections, and teachers are especially requested to bring their pupils on excursions to see the same.

A few properly prepared and labeled specimens will be sent by us free to any person in Pennsylvania engaged in making a collection for school, agricultural or other educational or practical public purpose. Also, in our collection are named and mounted specimens

Fig. 23.—Drawing of Butterfly showing a, egg; b, larva; c, pupa or chrysalis; d, adult, the four stages of insect metamorphosis. Original drawing by W. R. Walton in Office of Economic Zoologist.

of Pennsylvania insects in first class condition to exchange with any person, in any country, for specimens of desired species, especially those of economic value.

What a Collection Can Be Made to Show.

The old style entomologist was one whose chief outfit consisted of a net and a bottle of cyanide or chloroform. His purpose was to procure cabinet specimens, particularly of the larger and more attractive insects, or of very rare species. He rarely paid attention

to them in their immature stages, not being greatly interested in their life histories, food plants, enemies or remedies, but merely desiring to collect specimens, either showy or very rare, stick pins through them, and label them with scientific names.

The modern entomologist sees in his study of insects an opportunity to exemplify and illustrate practically all the great laws of biology and of finding and studying the many apparent exceptions thereto. The greater the number of forms or species of living things belonging to any one Group, the greater is the variation there shown, and the more interesting should its study become. The multitudinous host of insects in this State, reaching 240,000 species, is such as to present types of specimens illustrating many great natural laws, with variations of many remarkable kinds.

A properly prepared collection will show not only the types of the various Orders and Families of insects known and collected, but will also show the great range of variations which these insects have been obliged to assume in order to maintain their existence where competition has been so keen that the slightest advantage in difference of structure or place or method of living may mean the continuation of that particular form or variety, while the slightest disadvantage may mean dropping out of existence, or being forced to find another haunt, place or method of living, other food, or method of protection, etc.

The modern Collection will consequently show the following:

(1) **Specimens of all species or kinds** found in the region where it is made, arranged in systematic order, or in the major and minor groups of Orders, Families, Sub-families, Genera, Species and Varieties, respectively. This will be called the Systematic Collection, and the specimens should be named with labels bearing both the scientific and common names. It will be used chiefly for comparison in naming other specimens that will be collected, and will consist almost entirely of adult or mature individuals.

(2) **The Stages of Insect Life.** In this collection will be found fewer species of insects, but they will represent the stages or steps in the life history or development of any one or more species of each Family or Order, if they can be obtained. They will exhibit such stages or steps of insect life as the egg, the very young larva or nymph, the older larva or nymph after once moulting, and again the older form or stage, after moulting or casting its skin again, until the different molts of the immature form (i. e., larva or nymph) in its process of growth are illustrated; then the pupa or chrysalis will be shown, with its cocoon or earthen cell or other means of protection, whether it be suspended by a few threads, as the chrysalids of many butterflies, or merely wrapped in leaves,

or otherwise; and finally the adult or mature insects of both sexes will complete this group of specimens, showing the stages in the life history of one or more species. In many cases the larvae will be found feeding upon plants, and these are to be put into vessels, called Breeding Cages, kept covered with netting, and supplied with fresh food until they undergo their various stages, and finally appear as mature, adult, or fully-developed insects. If the eggs be desired, it is generally best to keep the adult insects until the eggs are laid, when after having preserved in bottles of alcohol or formalin, or otherwise, one or more specimens in each stage, they can be arranged so that the series is complete, from the egg to the adult. It is much more easy to find the larvae of insects, as they are conspicuous by the holes they make in the leaves or other places where they are feeding, than to find their eggs, and for that reason it is recommended to begin a collection to show the stages or life history, with the larval forms, keeping them in breeding cages and preserving in small bottles of alcohol or formalin one or more specimens of the insect in each of its stages, as it progresses during its metamorphosis.

(3) **Variations.** The variations of many insects from the typical forms in their respective groups are of considerable interest, and can be shown plainly in any properly prepared collection. For example, the Mole Cricket is indeed a "Cricket" and would belong with the insects of that Family, yet it has lived underground so long that its structure has become greatly modified, its body elongate, its antennæ are very short and modified into special "feelers," as are its palpi or small threads around the mouth, and its front legs have become modified for the purpose of making a tunnel as does the Mole, until they almost exactly represent, in miniature, the front feet of the common Garden Mole. Not only in form do they resemble this animal's feet, but also in position in which they are held, and in the way they do their work.

Again, the moths of the night-flying winged insects (Nocturnal Lepidoptera) nearly all have wings, and fly readily from place to place in the adult stage, but the females of the common Tussock Moth, which are the adults of the hairy caterpillars with red, black and white hairs so generally devouring the foliage of shade trees along our streets, have become so accustomed to simply spinning cocoons on the bark, emerging from these and laying their eggs upon the old cocoons that their wings through disuse have become quite abortative and are only small vestiges indicating that they once had wings, but these are now entirely incapable of use in flight. The female Canker Worms are entirely wingless, and climb the trees to lay their eggs. Collections showing variations of in-

sects should include such specimens, and the collectors and students making use of such collections will find great interest in the study of the cause of such variations in relation to the life history or places and methods of living.

Again, the common Bagworm, which is so very abundant and destructive to foliage throughout the southern and eastern positions of this State, presents a peculiar feature, the female not even transforming into the form of a moth, but in the fall she remains in the same bag in which she fed as a larva, and this acts as a protecting cocoon. Her eggs are laid within a protecting envelope consisting of the crysalis shell and within the cocoon-like bag. The young escape from this when they hatch in the spring, and crawl to the foliage of the trees, where they feed.

Such peculiar variations in structures are readily shown by specimens, and collectors who can not obtain specimens of the species here named can find in their own regions others just as peculiar or interesting in practically all Orders of insects. However, if it should be desired to show such peculiar features as those represented by the Bagworm in a region where this insect does not occur, it is very easy to obtain specimens by exchange. Nearly all Collectors are glad to exchange specimens, and we can give the names and addresses of persons who will be pleased to enter into such exchange, or shall be glad to make exchanges from our own collections.

A peculiar variation in the life history of insects is shown in the common Sheep Tick, which can be picked from almost any sheep in this State. This insect while wingless is really a fly, and this shows at once the results of the loss of an organ, such as a wing, through disuse, and through living where it would really be in the way. Not only is the Sheep Tick a wingless fly, but it shows the further peculiarity of a remarkably modified life history. The parent lives in such place that she can obtain an abundance of food in the form of the blood from the sheep. She does not lay eggs but retains them until after they hatch, and even until after the larvæ have developed and transformed to the pupæ or chrysalids when they are laid instead of the eggs. The little dark, hard, seed-like objects, often found in the wool of a sheep, and to be obtained at almost any time by catching a sheep and examing it closely, are really the pupæ or chrysalids of the Sheep Tick, and have passed the first two stages of transformation within the mature Tick before having been laid.

(4) **Means of Protection.** There is no broader field of insect study than that of the means of protection of each insect in each of its stages. The eggs, for example, may be protected by being deposited in water, as in the case of Stone Flies and Black Flies; or

in the form of little rafts on the water, as do the Mosquitoes, the eggs of which are easily obtained at this time of year by permitting a large pan of water to stand in a shady place a few days, when they will be found like minute black balls of soot that have fallen upon it; or they may be laid on objects over the water, so that the young larvæ on hatching will readily drop into it, as does the Corydalis, which is the mature form of the Helgramite or Dobson; or they may be deposited in the soil, as do many Grasshoppers, Beetles, Ground Beetles, etc.; or they may be deposited in decaying wood, as do some Grasshoppers and Crickets; or in living wood, as the Cicadas; or just beneath bark, as the Tree-hoppers; or on bark the same color as themselves, as the Katydid; or on leaves of their own color, which renders them inconspicuous, as many moths; or they may be scattered singly and be so small as to escape notice, as butterflies; dropped loosely among fallen leaves, as the Walking-sticks; covered with water-proof varnish, as the Tent Caterpillars; and many other means of protection in the egg state alone, which can not be discussed here for lack of space, are to be found by the collector each day if he really keep his eyes open.

In the larval or second stage many variations of means of protection may be found and exhibited, among some of which are the following: Living in water, as the Mosquito; living in water beneath stones, as the Stone Flies; living in water beneath sand, as many Dragon Flies; living in water in little cases, as the Caddis Fly larvæ; living beneath the ground, as the Cutworms, Wireworms, Ant-lions, and the larvæ of many Ground Beetles and flies, such as the Horse Fly; living in the stalks of plants, such as Stalk Borers and many others that are easily found by splitting the stalks of weeds and cultivated plants, and often bushes, such as elder or currant; boring in wood, as the Locust Borer; boring beneath bark, as the peach, apple and pear borer; living in the tissues of leaves, such as the Leaf Miner that makes little worm-like tunnels through the leaves; living in the roots of plants, like Clover-root Borers; living within fruits, such as Codling Moth and Curculio larvæ; living on vegetation but being of the same color, such as the Sphinx larvæ and many others; covered with spines or hairs, as many caterpillars and Beetle larvæ; throwing out offensive odors when touched, such as some of the butterfly larvæ, which can be found feeding on carrot, parsnip and celery leaves, and show their yellow horns when suddenly touched; carrying cases with them, such as Bagworms, some small beetle larvæ, and Caddis Fly larvæ; carrying their cast skins or exuviæ over them, as larvæ of some of the Leaf Beetles; living in tents, as the Tent Caterpillars; and other forms of pro-

tection in the larval state, which the collector will take pleasure in studying, and can devise means to show in his collection.

In the pupal state he will, for example, show such means of protection as the formation of cocoons, which may be fastened to twigs, as the Cecropia Moth, or laid entirely flat against the bark, thus being inconspicuous, as the Under-wings, or may be wrapped in leaves, which hang on the trees, as the Promethea Moth, or may merely fall to the ground among the fallen leaves, and there be concealed, as the Polyphemus Moth, or the pupa may be formed beneath the ground, as the Sphinx Moth or Hummingbird Moths, the Cutworms, Potato Beetles, etc., or it may be within the plant in which the larvæ live, as with the Clear-wings; or it may be suspended in some out-of-the-way place, as with many butterflies; or merely beneath the bark of fallen logs, boards, etc., in protected spots, as with many Beetle larvæ, and in fact, as most insects.

It is in the adult or mature stage that we find the most remarkable cases of protection, some of which are as follows: Imitating a green leaf, as the Katydid; resembling a yellow or dead leaf, as many Moths; looking like a flower, as some Moths and Butterflies; bright or conspicuous parts when moving but of such color as to be inconspicuous when quiet, as the Under-wing Moths, which are to be found on the bark of trees; assuming a threatening attitude, as the Stag Beetles; being provided with poison darts, as the Yellow Jackets, Hornets and Bees; mimicking or resembling stinging insects, as the Syrphus Flies, the Rove Beetles and the Clear-wing Moths; resembling spots or droppings on leaves, as many of the small light-colored Moths; assuming a green color, the same as the leaves on which they are found, as many Beetles and Flies; depending upon alertness, as the Grasshoppers, Leaf-hoppers, Butterflies, Tiger Beetles, Flies, etc.; being concealed in the ground, as the Ground Beetles, Ants, Termites, etc.; living in water, as aquatic beetles, Giant Water Bug, etc.; living on the water, as the Whirligig Beetles and Water Striders; having offensive odor, as most Heteroptera (Bugs), the Lace-wing, etc., offensive flavor or "taste," as Lady-beetles; living in nests, holes or trees, as Wasps, Crickets, Bees, etc., and other means of protection which the collector will observe and can exhibit.

(5) **Insect Organization.** The organization of those insects which are gregarious or live in colonies is always of great interest, and can be shown nicely in collections. For example, among the Termites, or White Ants, there are the Soldiers with extremely large heads and jaws, and workers with quite different appearance, as well as the winged forms or so-called kings and queens to be found in the spring of the year. By carefully excavating the nest of our

common White Ant, living so abundantly in woods, who can find the queen?

In a nest of Hornets at this time will be found the workers and the queen. The same can be said of the Yellow Jacket. In the nests of Ants will be found the workers, soldiers, queens, males, and often slaves of other species, besides other insects that may occasionally make their home with them.

One of the most interesting objects for illustration is the organization of the Honey Bee and its work. This should show the queen, the drone, and the workers, in their winged forms; pupæ of drones, workers and queen; and the larvæ of the workers and drones in their cells of respectively different sizes in uncapped comb and also in capped or sealed comb, the worker comb, the drone comb, the queen cells, the eggs in the worker cells and drone cells, the pollen or bee-bread, sealed honey, and both species of Bee Moths or Wax Moths in each of their stages.

The so-called Solitary Bees will be found of considerable interest, and their homes can be shown in the hollow plants in which their "nests" have been made, or in the wood that has been cut by the Carpenter Bee.

(6) **Means of Dissemination.** It is possible to show the means by which insects are disseminated from one locality to another, as follows: Primarily by their own wings, as most winged insects; upon infested wood that is to grow again, as scale insects; upon animals and other insects, as parasites; upon water, as insects found on running water; upon wind, as masses of cottony eggs, occasionally seen; by commerce, as those which feed in peas, beans and grains of various kinds; and by other means which will suggest themselves to the person who is a real student of the subject.

(7) **Food.** An exhibition of the food of various insects is of great importance and can be made without difficulty. Woods eaten by borers, such as the Goat Moth, or by the Locust Borer are easily obtained.

SPECIMENS RECEIVED DURING JULY, 1907.

Number.	Specimens.	Date—July, 1907.	Name and Address.
	Insecta.		
9691	Fly galls on Grape (Lasioptera vitis),	1	E. P. Miller, Altoona.
9692	Rose Chafer (Macrodactylus subspinosus),	1	P. Ruppert, Saltillo.
9693	Moth larvae,	1	L. S. Spang, Kelly Sta.
9695	Wooly Aphis, Apple,	1	R. Norris, Phila.
9697	Lepidoptera pupae,	1	J. A. Weaver, Kinzers.
9699	Two-spotted Lady Beetle (Adalia bipunctata),	1	D. R. Jack, Apollo.
9700	Sphingidae,	1	M. L. Witherup, Emlenton.
9701	Shad Flies (Sialidae),	1	C. A. LeFevre, Lisburn.
9709	(c) 17-year Cicada (T. septendecim),	2	W. O. G. and H. K. West, Danville.
9712	(b) Cecropia Cocoon,	2	Mrs. S. N. Kranmer, Granville Summit.
9718	Cat Fleas,	2	——, Harrisburg.
9719	Tortoise-shell Beetle (Coptocycla clavata),	2	J. G. Overdorf, Mifflinburg.
9720	Rose Chafer,	2	E. P. Holland, Woodville.
9722	(a) Elm Scurfy (Chionaspis americana), (b) Aphids,	2	W. C. Mauser, Bloomsburg.
9723	Terrapin Scale (Eulecanium nigrofasciatum),	2	D. M. Wertz, Quincy.
9724	Oyster-shell Scale,	2	J. J. Buckingham, Scranton.
9728	(a) Eyed Elater (Alaus oculatus (b) American Willow Sawfly (Cimbex americana),	2	J. Vallerchamp, Jr., Halifax.
9729	Insects,	2	G. R. Pritchard, Harrisburg.
9734	(b) Oyster-shell Scale,	2	R. E. Bohner, Loyalton.
9735	(b) Work of Flea Beetles,	2	S. Eberlig, Newburg.
9736	Rose Chafer,	2	H. B. Roland, Jr., Fox Chase, Phila.
9737	Beetle Larvae,	2	Miss M. L. Dock, Mt. Alto.
9739	Maple Aphids,	2	J. R. Snavely, Harrisburg.
9741	Rose Chafer,	2	R. R. Smith, Linden.
9742	Oyster-shell Scale,	2	C. Bernley, Berwick.
9754	Aphids,	3	C. F., Pennsdale.
9755	(a) Aphids, (b) Elater Beetles.	3	A. M. Dickson, Sandy Lake.
9756	Hemispherical Scale (Saissetia hemisphaerica),	3	J. E. Reinhart, Newburg.
9757	Corn Root Webworms,	3	J. F. Haveryley, Wellsboro.
9758	Terrapin Scale,	3	J. K. Wilton, Taylorsville.
9759	Io Moth,	3	R. M. Musser, Curtin.
9760	Parasitic Wasp (Thalessa lunator),	3	I. G. Stone, Wellsboro.
9763	Maple Aphids,	3	Harry Rauch, Reading.
9764	Clear-wing Moth (Sesia sp.),	3	E. Kerper, Harrisburg.
9769	(b) Beetle larva,	5	W. Angus, Stoddartsville.
9776	Oyster-shell Scale,	5	R. S. Breed, Kingsley.
9778	Luna Moth,	5	E. Leopold, Pottstown.
9779	Lecanium,	5	S. Matdernass, Jr., Robesonia.
9780	Moths,	5	S. N. Beecher, New Milford.
9782	Rose Scale (Aulacaspis rosae),	5	Miss J. S. Hogue, West Chester.
9783	Rose Chafer,	5	H. N. Hosteman, Boalsburg.
9787	Larder Beetle (Dermestes lardarius)	5	A. L. Graffain, Indiana.
9799	Rose Chafer,	5	E. S. Gottshall, Huntingdon.
9805	Eyed Elater,	5	M. A. Feterman, Catawissa.
9806	(a) Moth Eggs, (c) Arctiid Moth (Estigmene acreae), (d) Army Worm (Leucania unipuncta),	8	L. B. Gilmore, Saegertown.
9807	(a) Crane Flies, (b) Beetle larvae,	8	J. B. McGrath, Houtzdale.
9808	(a) Moth larva,	8	I. S. Spang, Kelly Sta.
9809	Oyster-shell Scale,	8	N. J. Wells, Tunkhannock.
9810	Rose Chafer,	8	Dr. R. Hayes, Jersey Shore.
9812	Lady Beetle pupae,	8	D. Preston, Berwyn.
9813	Rose Chafer,	8	Dr. J. S. Funk, Easton.
9815	Coptocycla clavata,	8	L. W. Ritz, Lebanon.
9816	Thalessa lunator,	8	G. Thomas, Whitford.
9819	(a) Scurfy Scale,	8	A. Baley, Dallas.
9821	Cecropia Moth,	8	E. T. Lemont, Mechanicsburg.
9822	Aphids,	8	D. A. Smith, Steelton.
9823	Galls of Fly (Cecidomyia verrucicola),	8	J. Rieg, Jenkintown.
9826	Apple Aphids,	9	G. C. Comstock, Montrose.

SPECIMENS RECEIVED DURING JULY, 1907—Continued.

Number.	Specimens.	Date—July, 1907.	Name and Address.
9828	Maple Aphids,	9	J. A. Rex, Norristown.
9831	Lady Beetle larvae,	9	C. H. Rich, Woolrich.
9833	(a) Aphids on Elm,	9	J. H. Patterson, Athens.
9834	(b) Lecanium sp.,	9	S. N. Baxter, Mt. Airy.
9835	(b) Thalessa lunator,		
	Oak Worm Moth (Anisota senatoria),	9	J. R. Derr, Sunbury.
9836	Ants,	9	Miss M. M. Haine, Cheltenham.
9837	Cloaked Knotty Horn (Desmocerus palliatus),	9	J. G. Crichbaum, Chambersburg.
9838	Dobson Fly (Corydalus cornutus),	9	U. N. Ruduh, Cheltenham.
9842	(a) Common Sulfur Wing (Colias philodice),	9	R. Martin and F. Fee, Harrisburg.
	(b and c) Dragon Flies,		
9851	Dobson Fly,	10	H. Simpson, Edgely.
9852	Rose Chafer,	10	Dr. Cott, Hecla.
9853	Maple Aphids,	10	E. R. Marvin, Pittsburg.
9855	Ground Beetle larvae,	10	I. L. Taylor, Smethport.
9856	(a) Grape Berry Moth,	10	C. E. Barr, Lancaster.
9857	Sphinx Moth (S. drupiferarum),	10	J. J. Krich, Monton.
9858	Wooly Aphis,	10	W. W. Polk, Phila.
9860	Beetle larvae,	10	A. Ryan, Hughesville.
9861	Wooly Apple Aphis,	10	Z. R. Schooll, Phila.
9862	Cherry Aphis,	10	B. F. McClellan, Harrisburg.
9863	Dobson Fly,	10	Post Office Dept., Harrisburg.
9866	Cecropia,	10	V. Harris, Harrisburg.
9867	Dobson Fly,	10	R. Martin and E. Kerper, Harrisburg.
9870	Aphids,	10	F. C. Bealor, Pittston.
9871	Magnolia Scale (Eulecanium cornuparvum),	10	A. W. Smith, Pittsburg.
9872	Ants,	10	W. B. K. Johnson, Allentown.
9878	Giant Water Bug (Benacus griseus),	11	J. L. Collner, St. Petersburg.
9879	Eggs of American Giant Water Bug (Belostoma americanum),	11	E. G. Bestedder, Trucksville.
9881	Work of Maple Aphis,	11	P. A. Small, York.
9882	Rose Chafer,	11	A. R. Schannauer, Wernersville.
9883	(a) Currant Sawfly larva,	11	G. R. Pritchard, Harrisburg.
	(b) Anisota eggs,		
	(c) Moth larva,		
9884	Terrapin Scale,	11	S. M. Rhone, Montgomery.
9885	Dobson Fly,	11	A. H. Rawson, Tioga.
9886	Long-horn Beetle (Xylotrechus colonus),	11	A. W. Young, Manheim.
9887	5-spotted Sphinx (Phlegethontius 5-maculata),	11	D. E. Zimmers, Bedford.
9889	Aphids,	11	W. R. Bairstow, Warren.
9906	(a) Sphinx Moth (Paonias excaecatus),	12	M. Burt, Emlenton.
	(b) Oak Worm Moth,		
9907	(a) Grape Phylloxera,	12	Mrs. A. Rissinger, Columbia.
	(b) Cottony Maple Scale (Pulvinaria innumerabilis),		
9908	American Giant Water Bug,	12	K. C. Mott, Meshoppen.
9909	(a) Work of Maple Aphis,	12	Miss Belle VanSant, Newtown.
	(b) Cherry Aphis,		
9917	(a) Parasitized Cherry Aphids,	13	B. S. McClellan, Harrisburg.
	(b) Bagworms,		
	(c) Work of Jassids,		
9919	Cecropia Moths,	13	J. E. Hostetter, Pequea.
9920	Maple Aphids,	13	Dr. R. M. Krebbs, Pine Grove Mills.
9921	Io Moth,	13	Dr. D. W. Bortz, Esterly.
9923	Cynip Gall (Andricus seminator),	13	Dr. I. M. Weills, Harrisburg.
9924	Oyster-shell Scale,	13	Mrs. L. Leavy, Clearfield.
9927	(d) Dynastes tityus,	13	K. Geist, Covington, Louisiana.
	(e) Jassids,		
	(f) Lantern Flies,		
9933	25 species of Insects,	15	S. M. Beecher, New Milford.
9935	Rose Chafer,	15	J. H. Schrope, Hegins.
9936	Jassids,	15	J. G. Pentz, Greenville.
9937	Five-spotted Sphinx,	15	J. H. Hauck, Mercersburg.
9938	Long-horned Beetle,	15	E. F. Blewett, Dalton.
9939	Moth larvae,	15	E. D. Hammond, Sayre.
9942	(a) Regal Moth (Citheronia regalis),	15	D. P. Shooks, Spring Mills.
	(b) Sphinx Moth (Phlegethontius carolina)		
9953	Stag Beetle (Lucanus dama),	16	G. Fungnieda, Womelsdorf.
9954	Eyed Elater,	16	C. L. Streamer, Phillipsburg.
9956	(a) Maple Aphids,	16	J. F. Fryling, Sunbury.
	(b) 15-spotted Lady Beetle,		
	(c) Lady Beetle larvae,		

SPECIMENS RECEIVED DURING JULY, 1907—Continued.

Number.	Specimens.	Date—July, 1907.	Name and Address.
9957	Butterfly larvae,	16	C. D. Wilrich, Moosic.
9962	Milkweed Beetle (Tetraopes tetraophthalmus),	16	A. I. Weckey, Eshcol.
9965	(b) Capsids,	16	D. W. Hazleton, Ambler.
9966	Aphids,	16	J. F. Hummel, Leeper.
9967	Pine Scales (Aspidiotus abietis),	16	Miss C. A. Creevy, W. Hampton Beech, N. J.
9969	June Beetle (Allorhina nitida),	16	E. Smith, Harrisburg.
9970	Flies,	16	J. Gibson, Harrisburg.
9971	Pigeon Tremex (Tremex columba,)	16	A. Barclay, Harrisburg.
9972	Paonias excaecatus,	16	J. H. Lovell, Glasgow.
9977	(a) The Cottony Maple Scale, (b) 15-Spotted Lady Beetle (Anatis ocellata),	16	J. F. Rohrer, Harrisburg.
9978	(a) Jassids, (b) Tree Cricket, (c) Lady Beetle larva,	16	J .B. Swaney, Hookerstown.
9988	Lady Beetle larva,	17	A. B. Miller, Barnesville.
9991	(a) Io Moth, (b) Rose Chafer, (c) Stone Fly,	17	J. W. Atkinson, Buckingham.
9992	Luna Moth,	17	L. C. Long, Listie.
9993	(a) Milkweed Beetle, (b) Dogbane Beetle (Chrysochus auratus),	17	J. F. Rupp, Shiremanstown.
9999	Stem-borer (Papaipema nitela),	17	Dr. I. M. Weills, Harrisburg.
10006	Army Worm,	18	H. E. Wainwright, Pittsburg.
10007	Dobson Fly,	18	P. S. Tooker, Easton.
10008	Lecanium,	18	M. I. Blackford, Freeport.
10009	Cloaked Knotty Horn,	18	S. Caprio, Lock Haven.
10010	Regal Moth,	18	S. S. Risser, Florin.
10011	Grape Vine Tube Galls (Cecidomyia viticola),	18	H. H. Roemig, Allentown.
10012	Yellow Swallow-tail Butterfly,	18	A. B. Miller, Barnesville.
10013	Grape Sawfly Larvae,	18	C. E. Risser, East Berlin.
10014	(a) Dobson Fly, (b) Tachina Fly (Bombyliomyia abrupta),	18	T. Earl Williams, Kittanning.
10018	Io Moth,	18	E. Hollinger, Harrisburg.
10024	Geometrid Moth,	19	Miss Gladys A. Beebe, Logan.
10025	Oak Gall (Amphibolips inanis),	19	F. S. Andrews, Wellsboro.
10027	Abbot's Sphinx (Sphecodina abbottii),	19	W. P. Williams, Pine Sta.
10028	Sphinx Moth (Pholus pandorus),	19	S. Caprio, Lock Haven.
10030	Terrapin Scale,	19	W. J. Connolly, Scranton.
10044	Bag Worm,	20	T. C. Sattherthwait, Lansdowne.
10046	Butterfly, Red-spotted Purple (Limenitis ursula),	20	A. V. Miller, Barnesville.
10049	Scavenger Beetles (Histeridæ),	20	C. H. Rich, Woolrich.
10050	(a) Red-humed Apple Worm (Schizura concinna), (b) Variegated Cutworm (Peridroma saucia), (c) Oyster-shell Scale,	20	J. G. Overdorf, Mifflinburg.
10053	2-Spotted Lady Beetle,	22	J. S. Fay, Williamsburg.
10054	Bag Worm,	22	H. Smithson, Willow Street.
10057	Variegated Cutworm (Peridroma saucia),	22	W. M. Schrock, Sumerset.
10058	Webworms,	22	Mrs. J. W. Stang, Springville.
10059	Variegated Cutworm (P. saucia),	22	J. H. Kurtz, Bellwood.
10061	Dobson Fly,	22	A. C. Wentz, Hanover.
10062	Sphinx Moth (Sphinx chersis),	22	E. E. C. Gibbs, Huntingdon.
10063	Eyed Elater,	22	G. W. Brown, Sabula.
10064	Lady Beetle pupae,	22	The Republican, Pottsville.
10065	(a) Dobson Fly, (b) Dragon Fly (c) Cherry Aphids,	22	A. F. Blewett, Dauphin.
10066	Moth Larvae,	22	J. Scharnbach, Germantown, Phila
10069	Cecropia Moth,	22	H. P. Templeton, Ulster.
10079	Lady Beetles, 4 species, Capsidæ, Tortoise Beetle (Cassida bicolor,	23	F. M. Bream, Gettysburg.
10080	American Willow Sawfly,	23	A. W. Buckman, Doylestown.
10081	Moth larvæ (Euthisanotia grata),	23	Mrs. J. Waugh, Washington.
10082	Long-horn Beetle (Prionus laticollis),	23	P. S. Tooker, Easton.
10085	Bagworm,	23	J. W. Prickett, Biglerville.
10096	Lady Beetle pupæ,	24	J. H. Zerby, Pottsville.
10097	11 species of Insects,	24	C. Strickland, Kingston.
10098	Cicada,	24	C. Strauss, Fredericksburg.

SPECIMENS RECEIVED DURING JULY, 1907—Continued.

Number.	Specimens.	Date—July, 1907.	Name and Address.
10099	Moth,	24	G. H. Bedford, Nazareth.
10102	Stalk Borer (P. nitela)	24	B. S. Bowdish, Demarest, N. J.
10103	Variegated Cutworm (P. saucia),	24	G. D. Dixon, Slateford.
10104	Pigeon Tremex,	24	J. L. Arnout, Planesville.
10105	Cutworm (Noctua c-nigrum),	24	J. T. Couch, Carnegie.
10106	Beautiful Maple Borer (Plagionotus speciosus),	24	E. R. Mulford, Wellsboro.
10107	Polyphemus Moth,	24	Dr. F. L. R. Heichold, Clearfield.
10108	Bagworm,	24	G. B. Smitheman, Phila.
10109	Scurfy Scale,	24	J. Hopkins, Juniata.
10112	Stalk Borer (P. nitela),	24	R. M. Stocker, Honesdale.
10120	(b) Wood Nymph (Neonympha eurytus),	25	Robert Templeton, Ulster.
10121	(b) Beetles (Dermestidæ),	25	Anna K. Bewley, Forest Grove.
10125	(d) Bird Louse,	25	R. W. Wehrle, Indiana.
10130	Bagworm,	25	Miss G. E. Keller, Milroy.
10132	Neuroptera, Netted-winged Insects (Sialidæ),	25	J. T. Black, Glenhope.
10133	Flat-headed Borer (Dicerca divaricata),	25	C. A. LeFevre, Lisburn.
10134	Parasitized Sphinx larvæ,	25	B. M. Stone, Stull.
10135	Bagworm,	25	J. R. Snavely, Harrisburg.
10136	Bagworm,	25	Mrs. G. M. Lehman, Essington.
10139	Noctuid larva,	25	Miss C. B. Steel, Tioga.
10140	(a) Variegated Cutworm (P. saucia), (b) Zebra Worm (Mamestra picta),	25	Mrs. A. F. Hughes, Tioga.
10141	Chrysomelid Beetle larva,	25	Mrs. F. O. Steele, Tioga.
10142	Rosy Maple Worm (Dryocampa rubicunda),	25	G. C. Kiddel, Devon.
10150	Magnolia Lecanium,	26	Hon. G. B. Orlady, Huntingdon.
10151	Bagworm,	26	R. H. Feltwell, Phila.
10152	Dobson Fly,	26	W. A. Spencer, Factoryville.
10153	Abbots Sphinx,	26	B. M. Stone, Stull.
10154	Cottony Maple Scale,	26	S. N. Baxter, Mt. Airy.
10155	Long-horn Beetle (P. laticollis)	26	C. H. Bedford, Nazareth.
10158	Stag Beetle,	26	A. Barclay, Harrisburg.
10160	Larva of Under-wing Moth,	27	H. B. Eberly, Shiremanstown.
10163	Lightning Beetle,	27	J. M. Karns, Everett.
10165	Io Moth,	27	R. B. Bayne, Etters.
10166	Dobson Fly,	27	A. B. Miller, Barnesville.
10175	White-marked Tussock Moth,	29	J. A. B. Patterson, Beaver Falls.
10177	Luna Moth,	29	W. S. Huey, Allensville.
10179	Elm Scurfy Scale,	29	J. G. Gardner, Bryn Mawr.
10180	Scurfy Scale,	29	C. F. Hayes, Curwensville.
10181	White-marked Tussock Moth,	29	Mrs. F. R. Masters, Copaka Iron Works, N. Y.
10183	(a) Variegated Cutworm (P. saucia), (b) Aphids,	29	G. M. Richards, Erie.
10184	Imperial Moth (Eacles imperialis),	29	J. P. Gibson, Harrisburg.
10185	Scurfy Scale,	29	E. Welles, Wilkes-Barre.
10194	Twice-stabbed Lady Beetle,	30	J. E. K. Vaughan, Osceola Mills.
10195	Imperial Moth,	30	J. D. Denny, Columbia.
10196	Syrphid Fly pupæ,	30	R. G. Conklin, Asaph.
10200	(a) Spotted Grape Leaf Chafer (Pelidonata punctata), (b) Abbots Sphinx, (c) Sphinx larva,	30	F. Glass, Churchtown.
10202	Oyster-shell Scale,	30	W. H. Chase, Conneautville.
10203	(a) Flat-headed Borer (Buprestis fasciata), (b) Jassidæ,	30	Miss L. Depp, Brookville.
10204	(a) Polyphemus Moth, (b) Red-humped Apple Worm,	30	C. H. Rich, Woolrich.
10205	Io Moth larvæ,	30	J. H. Sherman, Montoursville.
10206	Prominent Moth,	30	L. Bebranges, Wayne.
10209	Aphids,	30	S. N. Baxter, Mt. Airy.
10210	Long-horn Beetle (Orthosoma bruneum),	30	L. M. Kerlin, Liverpool.
10211	Cicada,	30	H. P. Templeton, Ulster.
10213	(a, b and c) Dragon Flies, (d) Dobson Fly,	30	W. F. Hill, Chambersburg.
10215	2 species of Dragon Fly,	30	C. F. Anderson, Harrisburg.
10217	Long-horn Grasshoppers,	31	A. B. Miller, Barnesville.
10220	Regal Moth,	31	C. E. Tice, Knobsville.
10221	Variegated Cutworm,	31	J. D. Gill, Sr., Phillipsburg.
10226	Jassid,	31	Mrs. S. E. Givens, Easton.
	Invertebrates not Insects.		
9721	Mites,	2	J. S. Snelbaker, Dover.

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THE SAN JOSE SCALE IN PENNSYLVANIA.

As the season for spraying is now near it becomes appropriate to consider important points in the life of the San José Scale pest and particularly the best measures for its control. Most of these subjects have been treated briefly in previous issues of our Monthly Bulletin (especially for November and February), but the editions of those Bulletins are now almost exhausted, and as we are receiving many requests for such information, which is so seriously needed in this State at present, it is here given with the hope that it will be of some use to the thousands of persons whose trees are now being destroyed by the pests herein discussed. It is very important for all persons having trees to ascertain if the San José Scale be upon them, and, if so, to treat them thoroughly in the proper manner before the buds burst in the spring. Send to us twigs supposed to be infested, and we shall reply at once.

1. Names and Pronunciation.

The San José Scale has a scientific name which is indicative of its bad character. This is *Aspidiotus perniciosus*. The first or generic name refers to the shell or scale which covers the small soft-bodied insect, and its second or specific name properly refers to its pernicious effects. The common name of this pest is given from the old Spanish town in California, San José, where it was first introduced in the United States, although the citizens of California declare it is unjust to call this the "San José Scale," as it did not originate there but merely tarried a while on its way across the country. The pronunciation and accent of that city's name are in accordance with the Spanish language—"San," rhyming with "pan," and "Ho-zay." Thus the name is not "Jose" (rhyming with "rose"), as it is pronounced by many persons.

2. Origin and Introduction into Pennsylvania.

In giving the information necessary to successfully control this serious pest it is not necessary to discuss at length its origin or history, but these points are of some interest and worthy of mention. The native home of the San José Scale is the northern part of China, in the region of the Great Wall, where it lives on fruit trees and other woody plants, and has been known so long that there is no record of its origin, but it has been held in check there by its

natural enemies, so that it has not over-ridden everything in that country, as it has here. An attempt was made to introduce some of these enemies of the Scale into America, but only one species of lady beetle was brought into this country, while no doubt there are many other insects which destroy this pest in its native region. The introduced Chinese Lady Beetle was found to be so attacked by parasites, in turn, that it was destroyed by them and has not thrived in this country. False hopes have been raised concerning the destruction of the San José Scale by means of its natural enemies, and while this is at least worthy of experimentation, nothing has yet been accomplished that could be called successful in this direction. All economic entomologists agree that the only way to save our orchards and produce fruit is to prepare to fight this pest with modern insecticides and apparatus.

This pest was accidentally carried on plants from China to Japan, and in the effort to introduce a Curculio-proof Plum the Japanese Plum was brought in an infested condition to San José, California. About 1887 some enterprising nursery firms in New Jersey procured from California a number of Japanese Plum trees which were hoped to be Curculio-proof, but unfortunately were infested with a more serious pest than the Curculio, viz., San José Scale. About 1890 and 1891 this destroyer of trees was sent on nursery stock to a few localities in Pennsylvania, Virginia and a few other Eastern states, and it was not until after these trees commenced to grow in the orchards that the presence of this pest in Eastern United States was discovered. From that time it has gradually spread by various means mentioned later, until millions of dollars would be required to pay for the loss that our fruit growers have sustained from its ravages. During the past fifteen years all other fruit pests combined have not proven so destructive as has this one—by far the smallest of all in size, but vastly more abundant in numbers and more certain and deadly in effect.

3. Methods of Injury and Effects.

The San José Scale, like all other scale insects, attacks its hosts or food plants by sinking a long proboscis through the outer bark and into the sap-bearing inner bark and sometimes even into the soft wood. After having thus become fixed it is impossible for it to be freed without breaking off the proboscis and thus killing the scale. It commences at once to inject a poisonous liquid into the part of the tree attacked and this often results in conspicuous red specks upon the fruit and twigs. This is particularly noticeable upon plum, apple and pear and also upon the green tender shoots of peach branches. It differs from other scale insects in the fact

that its injected liquid appears to be more poisonous to the trees than is that of any other species of this large family of pests. We know that some insects bite and sting us with greater pain than do others, and there is all reason to believe that in the pests which attack vegetation by sucking some are more severe in their attacks upon the trees than others. The San José Scale, although certainly the smallest of such pests, is at the same time the most destructive as well, because of its immense numbers and severe effects.

The poison in the infested apple and pear trees can often be detected by scraping away the tough outer bark and disclosing the crimson or purple stain in the inner bark. After modifying the sap of the tree by this injection of poison, just as the mosquito modifies or slightly changes our blood by the injection of its poison, the scale insects suck the sap from the trees, utilizing it for their own sustenance. The mere loss of sap by the myriads of these pests is not nearly great enough to account for the very serious results upon vegetation.

The infested trees can be detected even at a distance by their appearance of gradual decline. The injured twigs commence to die at the tips, as nature tries to keep the tree alive at the center or toward the base. Often the interior of the heads will be bushy, but the long bare dead branches will be seen reaching out beyond them, thus telling of the effects of the scale. Toward the last stage of the life of the tree small shoots will often be found starting out from the trunk or larger branches, and sometimes strong sprouts will grow up from the roots.

The San José Scale especially fixes upon the growing fruit of the plum, pear and apple, partly because these fruits are hard and smooth and furnish a good situation, and partly because the twigs, of apples especially, are often densely fuzzy and do not prove to be good places for the scale to fix. It is owing to the fine fuzz of the peach that the scale does not generally attack the fruit of this tree to any great extent, as it does the fruits of the others just mentioned. Its appearance upon fruit of any kind need not be considered alarming, as it can not possibly spread from fruit that has begun to ripen, because it dies on such fruits, and can not reproduce from them.

We have been asked if it "would be safe to wash, peel and cook the fruits carrying the scale, and eat them without danger of being poisoned." Such precautions are by no means necessary. To eat infested fruits raw and unwashed, would be more disastrous to the scale than to the consumer. The latter need not fear any evil results. In this connection it should be explained that sometimes a careful spraying of the trees results in driving many scale insects

from the trees to the fruit, for the reason that they do not readily fix upon the branches or twigs covered by the Lime-sulfur Wash, and the leaves, being fuzzy, do not afford a good abiding place. Thus the only thing to be done by the insects is to fix on the fruit, where they may appear in considerable numbers, although possibly not found in great numbers on other parts of the tree. Repeating the spraying when the leaves are off will give better results on fruit of the same tree the following year.

4. Kinds of Plants Attacked by San José Scale.

The San José Scale is not a serious enemy of all kinds of trees and shrubs, as has been stated or published by persons who do not know the pest by personal experience, yet it does attack a greater number of plants than any other pest found in this State. We have had it sent to us on tomatoes, and have found it upon golden rod and other weeds, but this was not important as it had simply fallen upon such plants from fruit trees upon which it was abundant, and was forced to fix itself and try to exist upon whatever growing plant it chanced to be upon, as it had no choice and could not do otherwise.

A mere list of the kinds of plants upon which San José Scale has been found or may be found in regions where it is very abundant is comparatively useless and misleading from the fact that it is known to fix upon almost any kind of plant, tree, shrub or vine, to which it is carried by natural agencies when in the young and free-moving stage, but it will by no means thrive or multiply upon all of them. Just as there are certain plants that cattle will not eat excepting under the most dire necessity, while there are others they prefer, so are there trees, such as the sycamore, yellow or black locust, maples, poplars, and others that the San José Scale is known to attack when it is abundant in the neighborhood upon other kinds of trees on which it thrives well, but it will not develop upon these to an injurious extent. The cultivated plants upon which it is most destructive and which therefore should be watched for its presence, are nearly all varieties of fruit trees, excepting the following: Sour cherries, wild goose and similar varieties of plums, and the Kieffer pear (the Kieffer but rarely being attacked). It is not usually injurious to quinces, but at times is very destructive to quince and sweet cherry, and will attack all varieties of peaches and kill them in two or three years, while it destroys currant bushes, all varieties of apples, most varieties of plums and pears, the osage orange such as is used for hedging, flowering quince or Japan quince, mountain ash, shadberry or June berry, and some other varieties of

ornamental plants and shrubbery, but not all by any means. The conifers, commonly called evergreens, and most forest trees, are free from its attacks. In regions where it has long been abundant we always find a much larger variety of plants attacked by it than where it has started but recently.

Upon some plants, such as the grape vine, it will not generally be so abundant as to become the cause of alarm, yet at some places where the supporting trees have been killed by this pest and nearly all fruit trees were infested by it, we have seen grape vines killed by its attacks as they were climbing over infested trees. Had the vines not been in such close contact with trees upon which the scale multiplies so rapidly, they would not have been so seriously attacked. A mere list of plants that have been known to be infested does not give much useful information for the reason that it does not express the degree of injury to which each particular kind of plant is susceptible. We give herewith two lists, the first of which is of plants commonly or badly infested, the second is of those species only occasionally or rarely infested. Excepting for accidental omissions, all species of plants not mentioned below are free from danger by the San José Scale.

Plants Commonly and Rarely Known to be Infested with San José Scale:

(1) List of Hardy Trees, Shrubs and Vines Commonly Infested:

Acacia, sp.
Akebia, sp.
Akebia quinata.
Almond, (Prunus amygdalus).
Almond, Flowering, (Prunus Japonica).
Apple, (Pyrus Malus).
Apricot, (Prunus Armeniaca).
Ash, American Mountain, (Sorbus, sp.).
Ash, European Mountain, (Sorbus aucuparia).
Basswood, Linden, (Tilia, sp.).
Beech, European or Purple-leaved, (Fagus sylvatica).
Cornus Baileyi.
Cornus sanguinea.
Cotoneaster, sp.
Cotoneaster vulgaris.
Crabapple, (Pyrus, sp.).
Crataegus cordata.
Crataegus Crus-galli.
Currant, (Ribes rubrum).
Currant, European, (Ribes nigrum).
Currant, Flowering or Missouri, (Ribes aureum).
Cherry, Choke, (Prunus Virginiana).
Cherry, Sand, (Prunus pumila).
Cherry, Sweet, (Prunus Avium).
Cherry, Wild Black, (Prunus serotina).
Dogwood, White, (Cornus alba).
Elm, (Ulmus, sp.).
Elm, American, (Ulmus Americana).
Elm, European, (Ulmus campestris).
Gooseberry, American, (Ribes Oxyacanthoides).
Hawthorne, (Crataegus, sp.).
Hawthorne, English, (Crataegus Oxyacantha),
Hoptree, (Ptelea trifoliata).
Japanese Quince, (Cydonia Japonica).
Juneberry or Shadbush, (Amelanchier Canadensis).
Lilac, common, (Syringa vulgaris).
Lilac, Persian, (Syringa Persicæ).
Linden, American or Basswood, (Tilia Americana).
Orange, Sour, (Citrus trifoliata).
Orange, osage, (Toxylon pomibrum).
Peach, (Prunus Persicæ).
Pear, (Pyrus communis).
Pear, Sand, (Pyrus sinensis).
Plum, Beach, (Prunus maritima).
Plum, European, (Prunus domestica).
Plum, Japanese, (Prunus triflolata).
Plum, Purple-leaved, (Prunus Cerasifera).
Plum, Wild Goose, (Prunus hortulana).
Poplar, (Populus, sp.).
Poplar, Carolina, (Populus deltoides).
Poplar, Lombardy, (Populus nigra, var. Ital.)
Privet, common, (Ligustrum vulgare).
Quince, common, (Cydonia vulgaris).
Quince, Flowering or Japan, (Cydonia Japonica).
Rose, (Rosa, sp.).
Rosa Carolina.
Rosa mucida.
Rosa Virginina.
Rosa rugosa.
Salix lucida.
Sand Cherry or Dwarf Cherry, (Prunus pumila).
Siberian Crab, (Pyrus baccata).
Scarlet Thorn, (Crataegus coccinea).
Snowberry, (Symphoricarpus racemosus).
Thorn, common, (Crataegus Crus-galli).
Walnut, Japanese, (Juglans Sieboldiana).
Willow, (Salix, sp.).
Willow, Laurel-leaved, (Salix pentandra).
Willow, Prairie, (Salix humilis).
Willow, Weeping, (Salix Babylonica).
Willow, Yellow, (Salix vitellina).

(2) Hardy Trees, Shrubs and Vines Occasionally or Rarely Infested:

Actindia arguta.
Alder, (Alnus, sp.).
Althea, (Hibicus Syriacus).
Arborvitæ, (Thuya occidentalis).
Ash, (Fraxinus, sp.).
Ash, White, (Fraxinus Americana).
Birch, (Betula, sp.).
Birch, Cut-leaved or White, (Betula alba).
Blackberry, common, (Rubus nigrobaccus).
Box, (Buxus, sp.).
Catalpa, common, (Catalpa bignonioides).
Cherry, Sour, (Prunus cerasus).
Chestnut, (Castanea Americana).
Chestnut, Horse, (Aesculus Hippocastaneum).
Cornus alternifolia.
Cornus Amomum.
Cornus candidissima.
Cornus circinata.
Cornus stolonifera.
Deutzia, (Deutzia, sp.).
Dewberry, (Rubus villosus).
Dogwood, Flowering, (Cornus Florida).
Eleagnus, (Eleagnus, sp.).
Elder, (Sambucus, sp.).
Eucalyptus, (Eucalyptus, sp.).
Euonymus, sp.
Fig, (Ficus Carica).
Forsythia, sp.
Globe Flower or Japanese Rose, (Kernia Japonica).
Grape, (Vitus, sp.).
Hackberry, (Celtis occidentalis).
Honeysuckle, (Lonicera, sp.).
Japanese Magnolia, (Cercidiphyllum Japonicum).
Jersey Tea, (Ceanothus Americana).
Laurel, Mountain, (Kalmia latifolia).
Locust, (Robinia, sp.).
Locust, Honey, (Gleditschia Triacanthos).
Maple, (Acer, sp.).
Maple, Norway, (Acer platanoides).
Maple, Sugar, (Acer saccharinum).
Maple, Weir's Cut-leaved, (Acer sacc.).
Mulberry, (Morus, sp.).
Mulberry, Weeping, (Morus, sp.).
Ninebark, (Physocarpus opulifolius).
Orange, (Citrus Aurantium).
Pecan, (Hicoria Pecan).
Persimmon, (Diaspyros Virginiana).
Photinia villosa.
Privet, California, (Ligustrum ovolifolium).
Raspberry, Red, (Rubus strigosus).
Rhodotypos kerrioides.
Sassafras, (Sassafras officinale).
Smoke Bush, (Rhus cotinus).
Sorbaria sorbifolia, (spiraea sorbifolia).
Spiraea, (Spiraea, sp.).
Spruce, White, (Picea alba.).
Sumac, (Rhus, sp.).
Silver Thorn, (Eleagnus longipes).
Virginia Creeper, (Ampelopsis quinquefolia).
Viburnum, sp.
Walnut, Black, (Juglans nigra).
Walnut, English or Persian, (Juglans regia).
White Rod, or Appalachian Tea, (Viburnum cassinoides).

5. Description and Life History of the San José Scale.

The living San José Scale insect is a minute, soft, lemon-yellow object or insect, concealed beneath a very minute black, flat-conical protecting scale, which is waterproof, and which is recognized in examination under a microscope by its distinguishing circular shape and black tip at the exact center, with a very small ring around this point. In the winter it is about three-fourths grown and remains in this condition until the warm weather of spring comes, when the insect injects more poison into the growing layer of the tree or shrub and sucks sap for its nourishment. It grows and its scale enlarges to nearly the size of a pin head and becomes of a brownish color rather than black, as in winter time.

From the 10th to the 15th of June the first young San José Scale insects appear. To the unaided eye they look like the most minute specks of yellow corn meal, but under a microscope they are seen to be oval in shape and have six legs and a pair of antennæ, as have other insects. They crawl about on the bark and leaves or fruit rather rapidly for such minute creatures, and may migrate for a distance of several feet from the parent that gave them birth, or they may fix very near her, even overlapping her shell. They exist in this young and free-moving stage only one or two days, or long enough to find a suitable place to sink their long whip-lash tongue or proboscis through the outer bark into the cambium or growing layer, or often into leaves or green fruit, when they commence to secrete a waxy covering, which comes through the pores of their skin. At first this is white, and perfectly circular, with the charac-

teristic little central point. This is their second stage or first fixed stage, and they are now known as "white sets." In this stage while not nearly as delicate and easily killed as they were when young and free-moving, they are yet more tender than at any later time. They inject poison into the part of the plant where they are fixed, suck out the modified sap, and grow, but can never again free themselves from this place, nor at any time let loose and move to another place, nor be scraped off and live. In the course of a few weeks they reach the third or black stage, described above as "the winter resting condition," and continue to grow until they attain the full size and brownish color of the adult scale, which is in about a month or less from their birth, when they soon commence to bear living young and continue this at the rate of several per day for another month or more. This kind of life history is continued until about the first of December. We have seen the free-moving young on fruit trees in orchards of this State as late as the fifth of December. During the winter those die which are not old enough to reach the properly protected resting stage, and also all of the old or full-grown individuals die then. Consequently, each winter as many as fifty per cent. may naturally be found dead upon a tree, but this does not indicate that severe weather is destroying any unusual number of them, nor does it show any gratifying decrease of these pests. Their multiplication is so rapid that it is estimated (U. S. Bulletin No. 3, page 44) to be possible for an individual to become the ancestor of 3,216,080,400 in one season. Since they multiply so rapidly, any agency or insecticide that would leave five per cent. of them alive upon the trees would be decidedly ineffective in holding them in check.

The males of the San José Scale are smaller than the female and undergo complete metamorphosis, or become winged in the fall. They then occur as exceedingly small, two-winged insects. The young insect may live and develop for about thirty days, more or less, according to temperature, before it commences to bear young, but the process of reproduction is so rapid that in one season one individual may become the ancestor of over three billion. Thus it is to be seen that this pest differs from the Oyster-shell and Scurfy scale and some other species of scale insects in the fact that it bears living young, while they lay eggs.

While the young scale insects are active they are, of course, unprotected, and are very delicate and easily killed. This was explained in detail in our June Bulletin for this year, Vol. IV, No. 2. Mild contact insecticides, such as dilute soap solutions, tobacco decoctions, oil emulsions, etc., which are used for plant lice, will also kill the young scale insects, but will not kill the adult or parent that is

treated at the same time with the same material. Our experiments have shown that it takes twelve or fourteen applications of contact insecticides at intervals of two or three days each to kill all the young scale insects as they appear and also to exhaust the reproductive capacity of the parent. The mature insect is covered by a thiner scale during the summer time, and thus is less protected and more easily killed than in the winter. We have tried repeated experiments with all kinds of insecticides, and have found nothing that will kill the adult or mature San José Scale while the green leaves are on the trees without also destroying the foliage. Of course, plants that are not bearing fruit may be treated with an insecticide so strong as to kill the scale insects, even though the leaves be taken off, but this could not be done every year, as it would soon result in the destruction of the plant.

Reproduction is continued until very cold weather, but the young that are born late in the fall die during the winter. When a tree has become so badly infested that it dies, its scale pests die with it. Also, when infested branches are trimmed from trees the San José Scales that are fixed upon these branches die as soon as the sap ceases to flow, and there is not the same necessity for burning these at once that there is for burning branches infected with fire blight or twig blight from which the disease germs are likely to spread at any time.

6. How and When Carried or Spread.

The methods of disseminating or carrying this insect from place to place should be understood by all persons who are growing trees or shrubbery. In order to get these points clearly in mind it is necessary to understand the life history of this pest as given in the previous section of this aricle. (See No. 5.) It should be kept in mind that the insect is able to move of its own accord only during the first day or two of its life, and it then fixes or fastens itself to bark, leaf or green fruit, and after a scale insect is once fixed it can never free itself nor move to another point. Thus it can be understood that the fixed or adult San José Scale is never carried or spread in such a way that it will live in its new quarters excepting when it is on wood that is going to grow again. In other words, the scale, when old enough to be fixed, is carried from place to place only upon plants that are to be transplanted or upon cuttings, buds, scions or grafts, but never upon fruit.

While the scale will be found upon ripe fruit it does not feed upon fruits after they commence to ripen, and hence does not multiply on them and is not spread while upon fruits that are ripe. It is perfectly safe to ship from one part of the country to another any

fruits that are infested without the least fear of danger in disseminating this pest, because it cannot free itself from the green fruits upon which it is fixed and does not live upon ripe fruit. After years of experiments with infested fruits of all kinds obtainable, we are prepared to say that we have never been able to obtain young scale insects from parents that were upon fruits which were commencing to ripen or mature. This shows the injustice of the laws of Oregon and of some of the European countries which attempt to prevent the introduction of the San José Scale there by the prohibition of the importation and sale of American fruits if infested and the confiscation and destruction of all shipments of fruits which have among them even a very few specimens of this scale insect. Such laws are but useless restrictions, as they are evidently based upon ignorance of the fact that the scale can not be carried into any country by such means.

After an infested tree is once planted in an orchard it is solely in the young or free-moving state this pest passes or is carried from tree to tree, unless infested cuttings, such as buds or grafts be used. To prevent its spread upon such cuttings these should be placed in a vessel that can be tightly closed, like a wash boiler, and fumigated with Hydrocyanic Acid Gas or Carbon Bisulphide. The means of carrying the young insects are various, as they are known to be transported by any agency that will bear them from one tree to another. Chief among these agencies are birds, upon the feet of which the young insects may crawl and be carried to a distant tree. Proof of this is found in the facts that frequently the infestation starts in that part of the tree where a bird's nest is found, and that the pest is more uniformly and extensively distributed where certain birds, such as the English Sparrow, are most abundant. Some persons have used this as an argument against the American Robin, but such reasoning is not proper, because the young scale is liable to be carried upon the feet of any kind of bird that will alight upon an infested branch, and it is also carried in a great many other ways besides by birds. Thus, if all the robins in the State were destroyed it could not perceptibly lessen or check the spread of the San José Scale.

This pest, when young, is also carried upon larger insects, such as grasshoppers, June bugs, and other beetles, flies, bees, etc., upon which it may crawl. A large and varied collection has been made of insects of larger size upon which this little pest has been actually found at the time of collection. It is also carried from tree to tree by squirrels, cats and other animals that may climb an infested tree and get the young free-moving scales upon their feet or fur and subsequently climb an uninfested tree and leave the pests there. They have also been carried upon the clothing of workmen passing

from tree to tree, and also upon larger animals, such as horses and cattle that walk beneath the infested trees and receive the pests dropping upon them and later accidentally brush them on other low branches. These pests when in the young state are also carried by the wind upon leaves or twigs that may be broken off, especially during storms, and we have positive evidence that they are disseminated by the wind in the fact that we have often found infested trees on the leeward side of one that originally had the scale, while on the windward side they were free from it. During the past year this feature was especially noticed on nursery stock grown in the vicinity of older fruit trees that were infested. The San José Scale is undoubtedly carried short distances through the air during the time it is young and free-moving, just as grains of dust or sand are carried, but not to the great distances that are sometimes believed.

Where the branches of trees intertwine it is possible for the San José Scale to crawl from one tree to another, and it often does this. Grape vines running over varieties of trees that are badly infested, such as peach, plum, pear and apple, are often found killed by the San José Scale, while they would not be seriously attacked if away from such trees, where the young pests could not freely crawl to the vines. There is absolutely no danger of the young San José Scale crawling down the tree and over the ground to other trees, because their tendency is to stay on the living wood or seek at once a bare spot where they can find a suitable place to fix, feed and live. Their occurrence upon the feet of birds is the result of short and accidental journeys rather than long and apparently premeditated migrations.

7. Why is the San José Scale so Destructive?

The following are some of the reasons why the San José Scale is so much more destructive than any other of the dozens of species of scale insects found in this State:

(1) It injects the most deadly poison into the trees. Its presence on young peach bark and fruits of nearly all kinds is generally shown by a large red blotch surrounding each scale and indicating the injected poison. By scraping off the outer bark of an infested pear limb the red blotches caused by this severe poison are plainly seen in the green bark and wood.

(2) It is so small (our smallest scale insect) that it is not observed, and its presence is often not suspected until its fatal effects are seen in the dying trees. It is then too late for any but the most radical remedies, intelligently and properly applied.

(3) It multiplies so rapidly that it soon covers a tree and spreads readily to others. According to the publications of the U. S. Department of Agriculture, one of these pests may become the ancestor of as many as three billion two hundred and sixteen million (3,216,000,000) in one season. Other common scale insects, such as the Oyster-shell or Scurfy, do not produce more than 600 descendats in a single season.

(4) Its ability to feed on many kinds of woody plants (not all species) makes it possible for it to spread more rapidly over a wide area, by being carried from one kind of tree or shrub to another, just as fire spreads only where there is combustible material.

(5) It multiplies by bearing young instead of laying eggs (as do most other species of scale insects), and as these do not appear at one time or in one brood and of one age, but at intervals of a few hours between each during the entire season, from June to December, and they spread by natural agencies only when young and free-moving (during their first two days), the San José Scale consequently spreads by natural means during nearly six months. However, the others such as the Oyster-shell Scale and Scurfy Scale, which lay eggs and hatch at one time, appear in broods and there are thus only a few days during each year when they are young and free-moving, and at which time they are spread from tree to tree by the agencies that carry them.

(6) They are so small that they are not large enough to nourish and sustain the same kinds of destructive internal parasites that hold in check nearly all other species of scale insects.

(7) They have been imported into this country without their natural enemies, and we have no insects or other creatures that feed upon them to a sufficient extent to prevent their exceedingly rapid increase and spread.

(8) The native home of the San José Scale is the northern part of China, which is naturally a cold country in the winter time, and as a consequence this pest is able to endure our severe winter weather without having its numbers greatly reduced by freezing.

(9) The San José Scale is so hard to kill by insecticides that these materials must be strong enough seriously to injure the foliage of trees in order to kill the old or fixed scales, and for this reason they must be treated when the trees are dormant or not in leaf, and can not be suppressed by spraying while leaves are present, as can many other species of insects. While spring spraying in May will kill the Oyster-shell and the Scurfy Scales, because they are then all in the young and delicate stage and easily killed by mild contact insecticides, such as Whale Oil Soap in water, or Kerosene Emulsion, dilute, the San José Scale insects are to be found in all possible

stages of development at all times of year after the appearance of the first young in the early part of June. Therefore, the spraying that would kill them in the young stage would not destroy all the San José Scale, because at the same time there are living old ones which would not be injured by the same material.

8. Natural Enemies of San José Scale.

Most other scale insects in this country are held in check by very minute wasp-like parasites, which lay their eggs in or on the pests and whose larvæ or young feed in the bodies of the scale insects, resulting in the death of the host. It is not uncommon to find the external coverings or shells of the Oyster-shell, Scurfy and Turtle-shell or Lecanium Scales punctured with many holes, showing where these internal parasites have escaped, yet the San José Scale is so very small that the parasites can not find in it enough substance to bring their larvæ to maturity and most of them pass it by without attempting to lay eggs in it.

The chief external parasite or insect which devours the San José Scale is the Lady Beetle. There are a great many beneficial species of this particular family in this country, but they do not appear to have developed a special appetite for the Asiatic foreigner. Professor Marlatt, of the United States Department of Agriculture, at Washington, went to Asia and procured and introduced into this country living specimens of one species of Lady Beetle, upon the efficiency of which high hopes were vainly based by many fruit-growers. Specimens were kept, multiplied, and were disseminated from Washington, D. C., but there is probably not one of these introduced colonies in existence to-day. Certain parasites in this country, and severe weather, combined to kill the beneficial Asiatic Lady Beetles by which fruit-growers were hoping for relief from their most dreaded foe. Our American species of Lady Beetles (or "Lady Birds"), both larvæ and adult, feed upon the San José Scale, especially in its young stage, but they do not hold it in control. There is at present nothing but the spray pump toward which we are justified in looking with certainty to save our property from destruction by the San José Scale.

9. Can it be Controlled?

We are frequently asked if the San José Scale can be exterminated, and we say, "No, but it can be controlled to such an extent that the very finest fruits can be produced upon trees where it has been existing for years, or trees and shrubbery can be kept vigorous and in nice condition, notwithstanding its presence." In making this statement we have in mind the difference between entirely extermi-

nating a pest, or in other words wiping it out of existence as a whole, or merely controlling it or suppressing it to such an extent that it does not appear in destructive numbers. As far as practical purposes are concerned, the control of pests is, in its immediate results, fully as satisfactory as entire extermination. The chief difference lies in the fact that when pests are exterminated, practical measures against them need not be repeated annually nor at regular intervals, but when they are merely controlled, the means of control or check must be applied more or less frequently or regularly, and if it be neglected they will again increase in such numbers as to prove overwhelmingly destructive. This indicates exactly our view of the San José Scale in Pennsylvania. We know where many fruit-growers and farmers have controlled it to such an extent that they no longer fear its ravages in the least, and have yearly produced as fine crops of fruit on trees that were previously badly infested as could be produced on any trees in the country. They are consequently satisfied with controlling the San José Scale alone and are not worrying about the impossibility of extermination. We are certain we would be misleading the public if we should say it is possible to exterminate the San José Scale in this State, even with an annual expenditure of millions of dollars and the employment of hundreds of men. However, it is certainly possible to help our citizens save their property in a satisfactory manner by an annual appropriation not amounting to one per cent. of the loss that would be sustained if such work were not done. It has been exterminated in a few orchards, as far as examinations can reveal, but this has required most careful effort.

The spray pump is an essential feature of every farm and orchard. Its use must become as familiar to the agricultural people as is that of the plow or reaper. In fact, our successful fruit-growers, who have this year sold thousands of dollars worth of fruit, will say at once that the most valuable piece of apparatus which they possess is the best spray pump they have used. It can be employed successfully against nearly all plant diseases, as well as against most insect pests. By its intelligent use such insects as the San José Scale will be effectually and satisfactorily controlled and the infested trees or shrubs will be left in even better condition than though they had not been attacked and sprayed. This is because the Lime-sulphur Wash, which is now generally acknowledged as the best and cheapest remedy, is a fungicide as well as insecticide and also destroys the plant disease germs, which are upon the tree at the time of application. The spray pump as a means of controlling the San José Scale and other insect pests and many plant diseases is as necessary in the hands of the intel

ligent fruit-grower as are lines in the hands of an intelligent driver for controlling and guiding a horse. Let fruit-growers take heed and faithfully follow the directions outlined in this Bulletin, and if they need help write detailed questions to this office and receive the assistance which we are willing to give without charge.

10. Remedies.

A great many different kinds of materials are suggested as remedies for the San José Scale, and many of these have more or less merit. However, to be satisfactory, it should have the following qualities: (a) Effectiveness in killing the scale. (b) Freedom of injury to the trees. (c) Cheapness as to cost and method of application. (d) Ease of preparation and application. These qualifications are mentioned in order of their importance. It must be acknowledged that no insecticide is known that is ideal in each of these four features, as far as can be proven by experiment or actual tests that have already been made. No tree grower is justified in using any newly devised material before it has been fully tested. It may result either in the death of the trees or in failure to kill the scale, either of which would be unprofitable to him. We discuss below some of the common insecticides in regard to the qualifications named above.

There are only three general methods of successfully treating trees or shrubs infested with San José Scale to destroy the pest without killing the trees. These are as follows: (a) Washing or painting; (b) Fumigating; (c) Spraying. It is to be observed that all of these are processes of contact applications, or remedies that must be applied externally, because the insects are suctorial. Internal applications or poisons, such as Paris green and other arsenites, will have no effect whatever upon the San José Scale, because it does not devour the tissue of the plant upon which the poison may be placed, but lives by sucking, and consequently can not obtain the material intended for it if this be offered as food to be eaten. It should not be necessary for us again to call attention to the fact that Bordeaux Mixture, which is a fungicide only, is not to be used as a remedy against insects, because a fungicide is only a preventive of plant diseases and will not destroy insects. However, we have recently heard of persons who have been spraying with Bordeax Mixture for San José Scale, and, of course, their labor and material were lost.

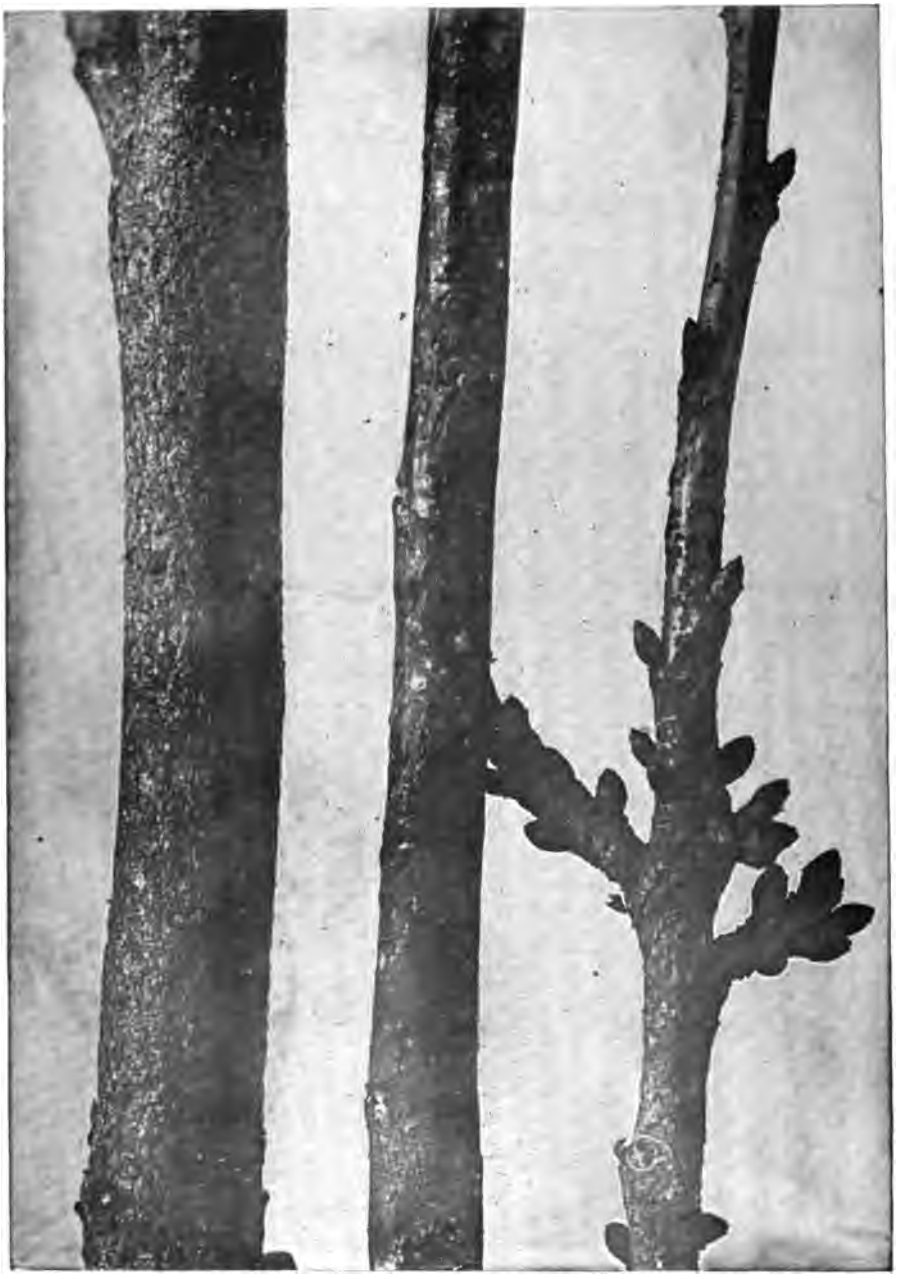
(a) Washing or Painting.—By washing is meant applying some liquid by hand, using something like a paint brush or whitewash brush. Since the San José Scales cover every particle of the tree to the tips of most twigs, and especially are found beneath buds

Fig. 1.—San José Scale (Aspidiotus perniciosus) on branch of Apple, natural size. On piece of bark at left, above, are magnified specimens. (By Howard, in Circular of Div. of Ent., U. S. Dept. Agr.)

a *b*

Fig. 2—a, San José Scale on Pear Twig, natural size; b, San José Scale, greatly enlarged, showing the crawling young and the different ages of the insect in the fixed stage. This shows just what can be seen with a good microscope on badly infested trees during the entire summer, after about the tenth of June. (From Howard and Marlatt, in Bull. of Div. of Ent., U. S. Dept. of Agr.)

PLATE XVIII.



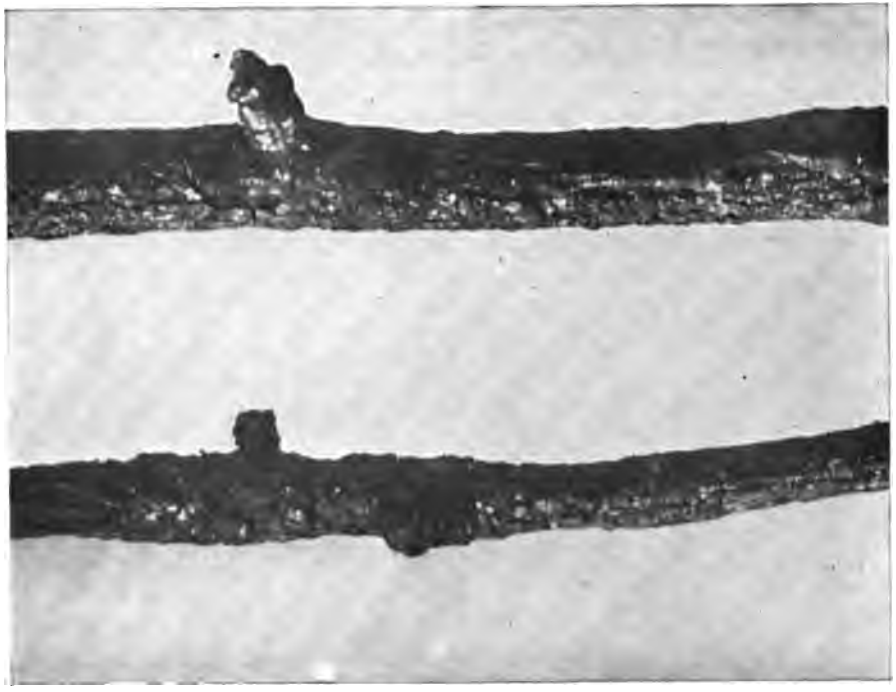
a b c

FRUIT TREE BRANCHES WITH SAN JOSE SCALE.
a. Scale in Winter Resting Stage.
b. Full grown or Adult Females.
c. Scale in Winter Stage, on Sweet Cherry.
All Natural Size.
Photograph of Specimens in the Office of the Economic Zoologist.

PLATE XIX.

Tree Showing Incorrect Methods of Pruning and Spraying. Terminal twigs clipped off last year made bunchy growth later.
Left side well sprayed, with the wind. Right side poorly sprayed against the wind.
Photographed in Orchard near Harrisburg, Pa.

PLATE XX.



Pear and Apple Branches Infested with living San José Scale, but injured by oil. Note the cracked bark just below the side spur in each.
Photographed, natural size, from Specimens collected in Dr. Groff's Orchard at Lewisburg, Pa., by the writer, H. A. S.

PLATE XXI.

and in cracks of bark, it is impossible to apply liquid by the washing process in such a way as to entirely and properly cover an infested tree unless it be one that is very small, or unless the tree be cut back or "dehorned," so that there is nothing to wash but the trunk and stubs of the main branches. Where trees are badly infested pruning is necessary to save them, and this dehorning process is urgently recommended as the best under such circumstances, especially for peach and plum. When the tops are cut off of the trees so that there are no small twigs remaining it is possible to apply a liquid insecticide with brushes and give a thoroughly good coat and obtain satisfactory results. We have reports of orchards in this State where the San José Scale has been almost exterminated by this means. Of course, it means the loss of the fruit for a year, but there will be excellent growth of branches and a good crop of fruit next year if proper care be given. When the bushy growth of several shoots commences around each stub all of these new shoots should be clipped off at once excepting those that are desired to grow to form the new top. This is one method of renewing peach and plum trees and has proven very successful in some places. Since apple and pear do not grow as rapidly as peach and plum there would be more loss of time in producing a new crop by cutting them back severely, but when badly infested this is the only way to save a tree of any kind whether future treatment be by spraying or by washing. One advantage of applying the insecticide with brushes is that there is no great cost of apparatus and as many persons can be started at the work as one may wish with no other expense than the cost of brushes and vessels to carry the liquid. It is a slower process than spraying, but if thoroughly done is sure to give good results. After painting the liquid thoroughly over the portions of the bark, the operator should look over it a second time after it is dry in order to retouch all spots, small as well as large, that may have been missed the first time. In applying insecticides as washes the operator should use just the same material that would be employed in applying it as a spray, excepting in using the boiled lime-sulphur wash, which is undoubtedly the best, less water can be added, thus making the mixture thicker, and it does not need to be strained.

(b) Fumigating.—Theoretically, the best way to kill insects is by subjecting them to the fumes of a deadly gas, but practically this can not be used on orchard trees owing to (1) the very great expense for outfits, (2) the time consumed in the operation, (3) the absolute necessity of an air-tight enclosure to hold the insects and gas during the process of fumigation, (4) the necessity of pure materials rather than adulterated, and (5) the danger of serious effects on trees or careless operators.

The best gas for fumigation is hydrocyanic acid gas made by dropping cyanide of potassium into a solution of sulphuric acid and water, but this is only useful in an air-tight enclosure. It has been tried very extensively by us in fumigating orchards, as well as by the entomologists of other States, such as Maryland, Illinois and California, and in every State in the Union excepting the latter it has been discarded as impracticable for growing trees excepting for those of very small size. Even in California, the only State in which it is yet used practically, we have reports directly from growers to the effect that most of them are using the boiled lime-sulphur wash with satisfactory results, and they are fumigating only the small trees and citrus fruits (orange and lemon.) Nursery stock can be fumigated very easily by packing it in houses erected for the purpose at the time of digging or before shipping. This fumigation of nursery stock when properly done with pure materials results in killing practically all of the insect pests on the trees without any injury to the latter. (Write for our Special Bulletin on Nursery Fumigation.) For insects in buildings we have fumigated experimentally a great many times during the past year with very decided success as the result of each experiment, but fumigation of orchard trees for San José Scale in this State will never become a general practice because the pest can be controlled so much cheaper by the means that our practical orchardists now have at hand and are using, or can be taught to use by our field demonstrators in their practical demonstrations. Fumigation is not "useless," neither is it economical nor practical under conditions in this State for any excepting very small trees.

(c) Spraying.—Spraying is applying a liquid in the form of a very fine mist. To be successful it should be in the form of a genuine spray, looking like steam or mist, rather than a sprinkle, throwing the liquid in drops. For this work a spray pump of some kind is necessary and a nozzle made for the purpose of throwing a fine spray is also essential. One can not spray with a sprinkling nozzle such as is used for sprinkling plants or washing carriages. While this may throw a stream it will not make a spray, and consequently will not have the desired results, because it can not be made to cover all the bark, especially of twigs, and it also wastes much material.

In a spray the liquid is so finely divided that it is in the form of small particles like water-dust or mist and can not be thrown against the wind. For this reason when the wind is blowing it is necessary to spray one side of the tree toward which the spray is carried and leave the opposite side to spray at any time in the future before the buds burst but after the wind has changed to a favorable direction.

It is best to spray the trees from four different directions in order to have the liquid applied entirely to all branches and twigs to the very tips.

a. How to Spray.—In preparing to treat very small trees or bushes it is best to have one man operate the spray pump and another hold the extension rod, carrying the nozzles. Commence to spray the top of the branches and carry the nozzle toward the interior of the tree, following each branch. Then turn the extension rod in such a way that the bend or quarter-turn will make the nozzle point toward the branch in a slightly different direction, and spray from that side. Then turn the spray to the opposite side by using a rod with a bend toward the end or an eighth-turn or quarter-turn attachment. Many branches and the trunk itself can be sprayed from practically three sides merely by turning the extension rod over, without the operator changing his position. After the top has been well sprayed, turn the nozzle upon the trunk and spray that from every side, so that it will be well covered, clear to the ground. No injury comes from enough material being used to run down into the soil, and this may be a decided benefit to peach and plum trees, as it can thus be used to kill the borers, if the gum and dirt are first cleaned away from the base.

For trees with low branches it is necessary to keep the apparatus low enough to pass under the branches or to drive between the trees. Where the branches are low and the trees close together, the tower or elevated platform cannot be used, but where there is room it is quite desirable to construct an elevated platform or tower, and have one operator stand on this. Time is saved by using a pump strong enough to carry two leads of hose. Thus one man operating the pump handle can give pressure or power for two sprayers, each holding an extension rod with two or three nozzles. With such equipment a tree can be sprayed in only a few minutes.

Completely encrusting all parts is necessary when using any of the lime mixtures. To neglect to spray all twigs to the tip with any material, means to leave a great many living insects on them, and thus have the tree reinfested by the descendants of these before the end of the growing season next summer.

b. When to Spray.—The time to spray depends in part upon the number of trees that one may have that need spraying and the amount of apparatus which he may have to do work, or in other words, the time that it would take to complete the job. Our experiments have proven conclusively that the best possible time of the year to spray is in the spring just before the buds burst, especially when using the Lime-sulphur combination, as this stays on the trees best when applied at such time, and has a desirable effect in keep

ing the young scale insects from fixing during the coming summer. However, a person should commence his spraying early enough to be sure to finish it before the leaves are out. Also there is danger of enforced loss of time by intervening bad weather, and the spraying should be begun in time to make due allowance for this. If the orchard be large it is advisable to spray the worst parts in the fall, or better, spray in the fall and again in the spring. If the work be thoroughly done, with a good insecticide, like the boiled lime-sulphur wash, applied in two coats, or retouched by the second spraying, it will not be necessary to spray again for two years.

c. What to Spray.—All trees and shrubs liable to be infested with San José Scale should be sprayed when they are known or supposed to be so attacked. It is not necessary to spray them if they be entirely free from scale. However, in a vicinity where the scale is common it may be taken for granted that all fruit trees are infested, and they should, therefore, be treated to save them before the pests become so numerous upon them. If, for example, there be only a few infested trees or shrubs upon the premises it is quite desirable to spray all that are of varieties attacked with scale listed on a previous page, because although there might be only a few specimens of San José Scale upon each tree at that time, and these could not be found even by a careful search, they would multiply to such an extent within a year as to justify the spraying now to kill them.

It is not at all wise to spray only trees that are visibly infested here and there over an orchard and leave the others untreated. If there be a scattered infestation on the premises there should be a general spraying. However, it is not necessary to spray maple, elm, walnut, hickory, ash and other some forest and shade trees. Look over the two lists given in preceding pages, and if your ornamental trees and shrubbery be not named in those lists, it is not necessary to spray them, even though they be standing near other trees having San José Scale. Of course, old fruit trees are liable to be infested, as well as young, and when this is the case they should be sprayed soon, because after such trees are badly injured they are not liable to regain their vigor and usefulness.

d. With What to Spray.—Materials or Insecticides.

The three general groups of insecticides which can be used successfully for control of the San José Scale are as follows:

I. The Lime-sulphur Compounds. II. Oils in some form. III. Soap Solutions. If used in proper proportion and in the correct manner any one of these can be made to give good results.

The kind of material to use depends in part upon conditions, such as the kind of trees or shrubs to be treated, their size, age, and condition of insect injury. Where a person has but a few trees in a

lot or upon a lawn, he can afford to give them much more time and care individually than though he had to treat several thousand trees in an extensive orchard, but at the same time he cannot afford the large or expensive apparatus necessary for doing thorough spraying upon large trees, neither can he always afford the time and trouble to make and apply the best known remedy—the boiled Lime-sulphur Wash, if he can hire his spraying done or do it for himself by using a good commercial insecticide.

I. THE LIME-AND-SULPHUR COMPOUNDS.

The best and cheapest materials for controlling the San José Scale, and also acting as fungicides to rid the trees of certain diseases which would otherwise attack them in the spring and summer, are the Lime-sulphur compounds made by heating Lime and Sulphur together until they form a new chemical substance, which is much different from either and has a greater chemical action than either alone. The best of these, because the cheapest that is effective, is the boiled Lime-sulphur Wash. There are a great many variations of the Lime and Sulphur Formulæ, but these variations are not important. As a general rule, it is better to use a few pounds more Lime than Sulphur just to meet the condition that the Lime is not pure while the Sulphur is so. This makes up for the probable amount of impurity in the Lime. However, it is not necessary nor desirable to use twice as much Lime as Sulphur, as it makes an additional amount of the substance that clogs the nozzle, without increased benefits.

(a) The Lime-Sulphur Wash.

The most common formula for this wash is as follows:

Lime, 22 lbs.
Flowers of Sulphur, 17lbs.
Water, 50 gals.

Put the Lime and Sulphur together, and use enough water to boil. Boil one hour, strain, and add enough water to make the fifty gallons required in the formula.

In regard to efficiency in killing the scale, beneficial results on trees, ease of obtaining material, and cheapness of original cost, there is no insecticide that can equal the boiled Lime-sulphur Wash. The only thing that can be said against it is the trouble in making and applying it, which is not great when the operator knows how to do it.

It is slightly troublesome to make but it has great advantages. Among these are the following: The exact proportions are not necessary. If a person should get a little more or a little less of any one ingredient he does not injure the efficiency of the Wash in killing the scale, nor will he thereby inflict any injury upon his trees. There is no possible danger of applying too much of this material to any kind of tree, as in using the oils which have been unduly advertised and applied with such disastrous results. No special apparatus of any unusual make is necessary in either making or applying this material. It can be applied at any time of year when the trees are not in leaf. By its white coating the operator can readily see what spots may have been missed and can thus be sure of the chance to retouch them, and the person who engages another to spray his trees can see for himself if the work has been thoroughly and properly done. (This is a very important point.) It is a fungicide as well as an insecticide and cleans up many of the disease germs, such as those causing leaf curl, ripe rot, leaf spots, rusts, smuts, mildews, bitter rot, apple scab, pear crack, black rot, and other diseases of leaves or fruits. It is not injurious in any proportion nor any amount upon any kind of tree even of the most delicate varieties. It is very cheaply made, costing but a little over a cent per gallon when dilute and ready to apply to the trees. Of no other known insecticide can the above statements truly be made. We unhesitatingly recommend it as absolutely the best, cheapest and safest remedy for controlling the San José Scale, and the slight trouble in making it is reduced to insignificance if the operator be provided with apparatus even no more complicated than two or three iron kettles set into a rough furnace or protected by stone walls along each side to retain the heat and keep the wind from blowing the flames away.

In general, the method of getting the lime and sulphur together before boiling is not at all essential; neither is the kind of vessel in which it is to be boiled. We have had equally good results with common iron kettles standing or suspended over open fires, common galvanized iron wash tubs on two walls of stone, box-shaped vats of sheet iron built for the purpose, furnaces constructed for boiling, and even kettles and boilers upon kitchen stoves. However, a copper kettle should not be used, as the chemicals will readily combine with the copper and ruin the vessel. We generally put the lime into the vessel in which it is to boil, sprinkle part (perhaps half) of the sulphur over it, pour on enough hot water to start it to slaking well but not to drown it, add the remainder of the sulphur and more water (hot or cold) in a short time, stir the masses well together, add enough water, hot or cold, to make it thin enough to boil well, stir to the bottom occasionally, bring it to the boiling

point and boil for at least three-quarters of an hour after it reaches this point. Many persons will say that they can get the red color by less boiling, but while this is true we do not think they can get the entire combination necessary for the best results within less than three-quarters of an hour from the time boiling commences. After boiling use cold water to dilute to the full amount required in the formula.

If the mixture is to stand for some time crystallization can be prevented by diluting it while it is yet warm. In this event, however, it should be again placed over the fire and heated before being put in the spray tank for the purpose of making it thinner and putting it through the nozzles in the best manner. If it be not diluted before cooling it can be prepared when wanted by diluting with hot water or skimming out the crystals and boiling them until dissolved and using this solution for diluting.

Where such material is needed it is advisable either to construct special tanks or vats for boiling on an extensive scale or to use live steam from an engine, conveyed by means of a pipe extending to near the bottom of the barrel of liquid to be boiled. By this means one can boil it in wooden tanks or barrels, and it is even possible by means of live steam to boil it in the tank from which it is to be sprayed, but in this case a basket-shaped, fine wire strainer should be arranged around the entrance to the spray pump. Often steam may be obtained by means of a threshing engine or stationary steam engine, especially such as a small engine at a creamery, and many persons may find it advisable to arrange to have their material boiled in this way. Such boiling has the advantage of doing away with the expense and trouble of kettles, and the work of stirring occasionally while boiling to keep from sticking to the bottom.

Where steam is to be had, as from a house heated by furnace steam, greenhouse, creamery, threshing, or other engine, it is an excellent plan to extend the horizontal pipe over a row of barrels and into each of these extend a vertical pipe almost to the bottom and boil the material by live steam. This, of course, can be boiled in barrels and does not necessitate stirring. It should boil fully one hour from the time real boiling commences.

The results with the lime and sulphur washes have shown that they are fungicides or preventives of such plant diseases as leaf curl of peach, brown rot of peach and plum, leaf spot, rusts, smuts, bitter rot of fruits, apple scab, pear leaf blister, etc. For this reason some of our best fruit growers say they will spray with this wash every spring shortly before their buds burst, even though they may not have much San José Scale.

sacks (100 pounds) or in barrels, with not less than three hundred pounds in a barrel, while the Flowers of Sulphur, which is the sublimated or more finely divided condition, is sold by wholesale only in barrels, but these barrels weight only one hundred and fifty pounds. In boiling the Lime-sulphur Wash there is practically no difference in regard to the form of powdered Sulphur used, for both forms are pure Sulphur; but in making the Self-boiled Wash or Caustic Soda Wash, depending upon hot water and chemical action for the combination of the Lime and Sulphur, it is better to have the more finely divided form, known as Flowers of Sulphur, because it is necessary to have every possible factor in favor of making the most perfect union of the chemicals with very little heat.

To mix the Sulphur or add it to the mixture the best method is to put it in a vessel like an ordinary kettle or water bucket, and add enough water to make it possible to stir it into a paste or mush. Then add this wet paste of Sulphur to the mixture, and it will enter the water readily and not stay on top in little dry yellow lumps, as it does when the dry Sulphur is added to any mixture containing water. Sulphur can be kept many years without losing its beneficial qualities, and as it is useful in destroying other pests, especially parasites on fowls and live stock, it is well to buy it by the barrel and keep it on hand.

The Lime.—The lime should be the best possible quality of calcium to be obtained, and a grade which is as free as possible from sand or sediment. Where there is much sediment this can be determined by slaking some of the lime, and adding enough water to make a milky solution, stirring, pouring off the milk of lime and examining the deposit at the bottom. If there be much sediment it will be better to slake the lime and make a milk of lime before boiling, and strain it before putting it into the vat or kettle in which it is to boil. At all times the mixture should be strained through a fine wire netting when it is poured into the tank from which it is to be sprayed. It is important that the lime used should be oxide of calcium or true lime instead of oxide of magnesium or magnesium lime.

Many persons have noticed that sometimes in boiling the Lime and Sulphur together to make the Lime-sulphur Wash the color becomes brick red, or more exactly the color of cooked tomatoes and remains so, while at other times it first becomes dark red, but by a little further boiling turns to a dark olive green color. There is evidently a cause for this difference, and this is no doubt to be found in the difference in the chemical composition of the Lime. It has been and is yet the opinion of most persons that the red mixture is to be obtained only with Calcium Lime or Calcium Oxide,

while the olive green color comes from the use of Magnesian Lime or Oxide of Magnesium. We know that the latter is more mild in its action, and for this reason it may not have such decidedly killing effect upon the scale. We have previously directed operators to use the Calcium Lime, as we wish to be sure of best results. We have not been able to have chemical analyses made to confirm our suspicions in this regard, but we are now gratified to see that Prof. Smith, of Georgia, in a recent Bulletin on the San José Scale, endorses our view in regard to the Calcium Lime being more efficient than the Magnesia. (See Summary from the Georgia Bulletin published in the last December Bulletin.) It is no doubt owing to the difference in the character of the Lime that the discussion arises from persons in different parts of the country as to how long the material should be boiled, as far as color becomes the criterion. Some say the length of time for boiling is until it becomes olive green, and others say that they find it impossible to do this, as it remains dark red. It certainly is not necessary to boil it longer than one hour of actual boiling, whether the color be green or red, but it is important to not stop the boiling as long as any light yellow sulphur can be stirred up from the bottom. Boil until this is all gone. Stir to the bottom occasionally, but it need not be stirred all the time.

To Keep Lime Fresh.—It is often necessary to buy quite a quantity of lime at one time and keep it in stock ready for use in the future. If kept dry or exposed to the air it will become air-slaked or undergoes a chemical change which results in a form of lime entirely different from that which is produced from slaking with water. The air-slaked lime is not suitable for making the lime-sulphur washes, and this may be one reason why persons who have used it have not had better results with the lime-sulphur-salt wash. Quick lime or fresh lime is always required, but this can be slaked when received and kept in a barrel or other vessel, under water, in the form of paste or putty. Keep it covered with an inch or more of water so that it will be wet all the time, and it is ready for use whenever needed. Dip out the amount required in any formula, making allowance for the added weight of the water in which it is mixed. This means three times as much of this putty of lime should be used as is required in a formula calling for unslaked lime.

The Strainer.—Nearly all firms making spraying apparatus now make and sell strainers especially adapted to strain such materials as the Lime-sulphur Wash. However, most of them are so constructed that they readily clog and give a great deal of trouble. There is no one feature of spraying with the Lime-sulphur Wash that is more disagreeable or annoying than the clogging of the

nozzles. All who have sprayed with the Lime-sulphur Mixture will emphatically agree with us in this statement. Yet we have been able to spray for one-half day at a time with material made according to the regular formula, without one clogged nozzle during that time. This is accomplished by cleaning the kettles, barrels and spray tanks well, especially the interior of the tank and hose, so

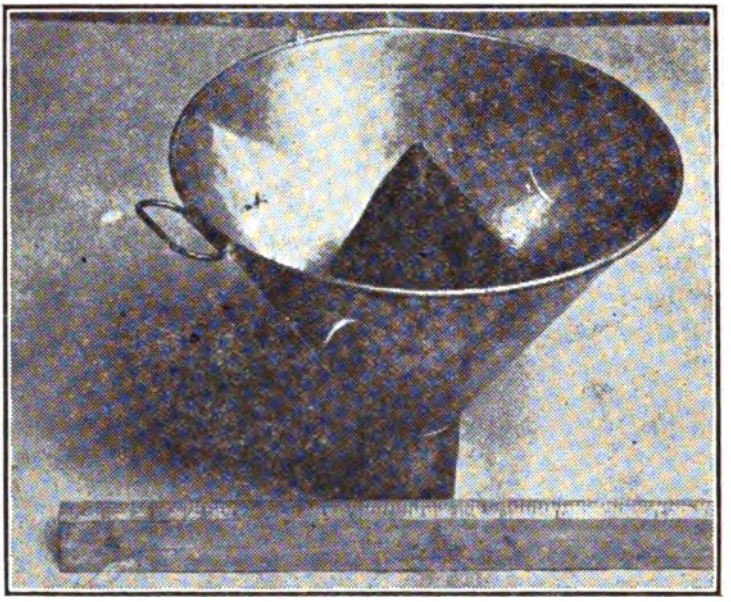


Fig. 24. Conical Strainer for straining Lime-Sulfur wash easily. Made under the direction of the State Zoologist and photographed in his office.

that no dirt will be in it before the mixture is added. Then strain the mixture properly and afterward keep the tank covered so that pieces of bark and other small particles can not fall into it from the trees under which it is drawn, and later find their way into the nozzles.

In straining, a piece of wire netting or cloth should be used, which has the wires at least as close together or as many as twenty-six to the inch. Window screening will not do for this. Gunnysack or Coffee Sack is quite poor material to use for straining. In fact, no cloth is suitable for this purpose. The lint or fibres are liable to be carried into the spray tank and readily clog the nozzles. In straining with cloth some threads are liable to be pushed aside and larger particles than are desired will crowd through them.

The best commercial or ready-made strainer that we have seen is one that has a large flat sheet of wire soldered across at an angle, in such a way that one side is much higher than the other. The

liquid strains through this fairly well. The poorest metal strainer that can possibly be used is the one that is merely a sheet of wire placed flat across a funnel, as most strainers are, and the best that we have ever used and which we are now placing in the hands of our demonstrators is made by our tinner, and consists of a cone of fine brass wire netting placed upright in a funnel in such a way that the base of the cone comes down inside the funnel, toward its lower part, and the apex or point of the cone stands up inside the middle of the funnel and is strengthened or supported by a few heavier wires or a very coarse wire netting (one-fourth inch mesh) fastened under it from the under or inner side, before the fine wire is put into place. Through this conical strainer the Lime-sulphur Wash runs almost as freely as water, and at the same time the straining is done very thoroughly. The sediment collects around the upper base of the cone in such a way that it can be thrown out or put back into the kettle for further boiling as may be desired. As far as we know this device is our own origin, and not being patented is offered to the public as a great convenience in this work.

(b) The Lime-Sulphur-Soda Wash.

Fresh lime, 22 pounds.
Sulphur, 17 pounds.
Caustic soda, washing soda, or lye, 4 or 5 pounds.
Water, 50 gallons.

This is recommended as a good lime-sulphur wash that need not be boiled if made with great care. It can be made in a barrel, tub or vat without the addition of any other heat than that which is produced by putting the materials together in the proper way. This is done by slaking the lime with hot water and adding about one-third of the sulphur to the lime before it commences to slake. Keep the barrel covered with wet blankets or carpet. Before it has finished slaking add another third of sulphur with a little more hot water, and by the time it is done add the remainder of the sulphur, add more boiling water and stir the mixture together; dissolve the caustic soda or lye in hot water and pour about one-third of this solution into the barrel and cover it quickly with blankets. A great deal of steam and gas will escape, but as much heat as possible should be held in. Let it stand ten minutes, stir it well and add the second third of the caustic soda or lye dissolved in hot water, cover it again immediately, and let it stand ten minutes more. Now stir it again, add the remainder of the caustic soda dissolved in hot water, cover it quickly and let it stand again ten minutes, when it is ready to add enough water to make the entire amount 50 gallons, and apply either as a spray or wash, just as in using any other lime-sulphur mixture.

We know where this has been made and used with emphatic success, and for comparatively few trees, where one is not equipped to make the boiled lime-sulphur-salt wash, this can be made without the necessity of boiling, but at slightly increased expense. It is as satisfactory as any of the other washes of its general class, both as an insecticide and as a fungicide. It can be made with water heated in a wash boiler on a kitchen stove.

Caustic potash, or washing soda, or even concentrated lye, such as is sold in the stores for making soap, can be substituted successfully for the caustic soda, and it is probable that strong lye made from wood ashes can be used with equal success in place of soda. Unless made with great care, in order to procure and use all the heat possible, it will not be as effectual as the boiled wash.

(c) Livers of Sulphur, or Potassium Sulphide.

Potassium sulphide or livers of sulphur, 1 pound.
Fresh lime, 1 pound.
Warm water, 2 gallons.

Mix these together and apply as a spray or as a wash with a brush when the trees are dormant, or paint this mixture on the bark at any time. This is to be used in exactly the same manner as the other lime-sulphur washes, and is both an insecticide and a fungicide. It can be made in any kind of vessel and needs no other heat than that in the warm water. It is the most easily made insecticide that can be recommended for the San José Scale, and is therefore especially useful where one may have but a few choice trees which he may wish to preserve without the trouble of making either of the preceding mixtures. While it is the most easily made substitute for the boiled lime-sulphur-salt wash, it is at the same time the most expensive of this series of insecticides, and, owing to the cost of the potassium sulphide, it cannot be used in large orchards or on many trees.

II. OILS FOR THE SAN JOSE SCALE.

There are several forms of oil that can be used with more or less success in killing San José Scale, but these must be used with care and with a full knowledge of the possible evil results of improper methods. One great value of the lime-sulphur-salt wash is that an inexperienced person cannot apply enough material prepared by any of the foregoing formulæ to injure the plant, while many trees have been killed by the application of too much oil or a mixture containing too high percentage of oil, or by oil of an improper grade. Trees vary in their liability to injury by such substances. While pear trees can often stand a spraying of pure petroleum or even a light spraying of pure kerosene, oil should not be applied stronger than 50 per cent. to apple, nor stronger than 40 per cent. to plum.

nor more than 25 per cent. to peach trees. In order to reduce the percentage it is necessary to apply the oil either in the form of a mixture, which is to be mixed by a mechanical device at the time of spraying, or in the form of an emulsion, in which the particles of oil are kept suspended in the mass of the diluting mixture, which is generally water.

No oil should be applied on trees until it runs down in streams and branches should never be soaked with it. It is particularly liable to injure the larger branches of trees by being absorbed by the thick bark, causing the death of this covering. We have seen many fine trees badly injured by the excess of oil that penetrated the thick bark of the branches. It is singular that this substance will not injure the thin bark of the trees as readily as the thick spongy bark, which seems to hold it longer.

(d) **Crude Petroleum.** Crude petroleum is a first class remedy for the San José Scale upon pear trees, but care should be taken to avoid soaking the thick bark with it. If this be used the operator should purchase only that which has a specific gravity of 43 degrees, Baume, or higher. Undilute crude petroleum cannot be safely used on apple and the other fruit trees, except pear. Several persons have killed plum trees with this material. (See Injured Branches, Plate XXI.) A fruit grower in Jamesburg, N. J., recently told the writer that he had killed all his plum trees and 500 three-year-old pear trees by spraying them with crude petroleum. On the whole it is not as good an insecticide as the lime-sulphur-salt wash and does not have the added advantage of being also a fungicide.

In spraying with oils there is less danger of injury if the work be done on a bright sunshiny, slightly windy day. so that the evaporation will be as rapid as possible. The heavy crude petroleum, which contains paraffin, with but little vaseline or asphaltum base, is more likely to kill the scale without injury to the tree than the lighter varieties of this form of oil. The oils with vaseline or asphaltum base are especially injurious.

Oil Emulsions.

A good way to apply oil at a certain desired percentage of dilution is to make it into an emulsion. By this means one does not need an especially made spray pump, and with care he can obtain exactly the percentage of oil which he desires.

Make a stock of kerosene emulsion as follows:

(e) **Kerosene-Soap Emulsion.** Hard soap, or whale oil soap, one half pound; water, 1 gallon; kerosene, 2 gallons. Shave the soap fine in boiling water and thus dissolve it, remove this soap solution from the stove and add it to the kerosene while the water is boiling

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A GENERAL SYSTEMATIC STUDY OF INSECTS. PART IV.

ORDER HEMIPTERA, THE BUGS, LICE, CICADAS, APHIDS AND SCALE INSECTS.

SUB-ORDER B. HOMOPTERA. THE CICADAS, PLANT LICE, SCALE INSECTS, ETC.

Family IX. Coccidæ. The Scale Insects, Bark Lice and Mealy Bugs.

In our Monthly Bulletin for January, 1906, Volume III., No. 9, page 274, we commenced "A General Systematic Study of Insects—Part I." In that Bulletin was published a brief discussion of the Arthropoda or "Joint-footed" animals, and a fuller treatise of Hexapods or True Insects, and the relationships of the three other classes composing the sub-kingdom. We there published concerning the chief of the lower Orders of Insects. The last was concluded on page 292 of Volume III. This subject was resumed in Volume IV., No. 2 for June, 1906, page 48, completing the study of the Sub-order Heteroptera, or True Bugs, on page 72. It was further resumed on page 69 of Volume V for July, 1907, discussing the various Families of the Sub-order Homoptera, excepting the Coccidæ or Scale Insects, and concluded on page 86 of this Volume. We take this occasion to offer the correction that the egg punctures shown in Fig. a, Plate IX., of the July Bulletin are not made by the Buffalo Tree-hopper, but by another species of the same genus known as the Cow Tree-hopper, scientific name, *Ceresa taurina*.

It now remains for us to discuss the Family Coccidæ or Scale Insects and thus conclude the study of Homoptera, or the second Sub-order of the large Family of Hemiptera, generally and properly called "The Bugs."

To the Family of Coccidæ belong those insects known as Mealy Bugs, and also the Scale Insects or Scale Bugs, sometimes called Bark Lice. In the adult stages especially these creatures do not resemble those forms of life that we are accustomed to call Insects, and it is difficult for the uninitiated to observe one of them and realize that it is really a living insect. They are distinguished by their fixed condition or "sedentary habits," the structural mouth parts, and the waxy or scale-like covering or the gall-like form of the body of the adult.

A peculiarity of the Coccidæ is the remarkable fact that the males differ from all others previously discussed in these Bulletins by undergoing complete metamorphosis, or in other words transforming from the larva to the adult through a third or chrysalid stage, and appearing in the adult form as winged creatures, entirely unlike their former selves or the females of their own species. These adult male Scale Insects have only a single pair of wings and are extremely delicate in appearance and texture. They are further remarkable for the fact that they have no beak or mouth parts for partaking of food and do not eat or feed when in this mature state. A second pair of eyes appears in the place of the mouth parts. The only winged forms of Scale Insects are the males, as the females never develop wings, and are active only in a very few species.

The scale insects are truly listed as among our most destructive pests, for the reasons (1) that they are so small as to escape observation until after they have seriously affected the plants on which they are found; (2) they live by sucking juices rather than eating away the tissue of the plant; and hence are not conspicuous in their methods of attack; (3) they multiply so rapidly that they may cover a plant before their presence is suspected; (4) they inject a poisonous saliva or juice into the plant by which it is severely injured before sucking out its sap, just as the mosquito injures us mostly by the injection of its venomous saliva; (5) some of them attack a large variety of plants, and thus they spread more rapidly and certainly than though conveyed to but a few species of the vegetable kingdom; (6) they are very easily carried long distances while living, being disseminated upon plants either in growing or dormant condition. Wherever plants are carried by mankind, there their pests, in the form of Scale Insects, may be expected.

Notwithstanding the serious destruction by the insects of this Family, it must be recognized that some are also of economic value. For example, cochineal, which is a red dye commonly used for cakes and candies, is nothing more than the dried bodies of insects of this Family, collected by scraping them from the cactus plants of Mexico. Shellac, a common form of varnish, is prepared from the shells or covering of Scale Insects living on tropical trees, and China Wax is also a product of Scale Insects of Asia. Considerable employment is given to persons engaged in the collection and preparation of such material.

The Coccids multiply either by bearing living young, as does the San José Scale, or by laying eggs as do the Oyster-shell Scale, Scurfy Scale and others. With all species the young move freely and may crawl around over their food plant for a period of time,

varying from a few hours to a few days, and may possibly reach a distance of several feet from the parent. It is during this young and free-moving stage only that they are carried from tree to tree or from plant to plant, excepting when they are fixed on wood that is to be used for further growth, as on young trees, cuttings, buds or scions.

All kinds of young Scale Insects are carried upon the feet of birds of many kinds that alight in the trees when the pests are young and moving. They are especially liable to be transported by the English Sparrow, because these birds live almost continuously in flocks, are found abundantly near the abode of man, alight in bushes and small trees, and fly only short distances in their rather heavy flight. The fact that such insects are carried to a great extent upon the feet of birds is proven by the common occurrence of these pests on the branches of trees near birds' nests. The American Robin has been unjustly condemned for its instrumentality in carrying Scale Insects, as there would be just about as many transported by other means, even if these pests should not occasionally find their way to the feet of any Robins perched on infested limbs. Young Scale Insects are also blown through the air, as are fine grains of sand, as proven by our commonly finding them on plants beyond infested trees, in the direction they would be carried by the prevailing wind. They are also carried from plant to plant upon leaves or twigs that would be broken off the parent tree and thrown or blown away, as in a storm.

The larger insects, such as June Bugs or May Beetles, Grasshoppers, Butterflies, Katydids and Bees often unconsciously transport young Scale Insects which crawl upon them, when alighting on their trees. Quite a collection of insects has been made transporting upon their bodies, smaller individuals, which have actually been found to be young Scale Insects. This proves that such a statement is not the assertion of mere theory.

Another means of conveyance of these pests from tree to tree is by squirrels, cats or other animals that would run up the tree or over the branches when the insects are in their young and free-moving state, and which cling to the fur or feet of the animals. Such pests are also disseminated by crawling from branch to branch, where the branches of different trees intertwine, and are also liable to fall upon the backs of horses or other domesticated animals beneath the tree, and thus be carried from one part of the orchard to another. It has also been proven that they may be carried upon the clothing, hands or tools of workmen engaged around the tree during the period when the young are moving and in a condition to be conveyed from one tree to another. It is of considerable

practical importance to bear in mind that Scale Insects are carried from tree to tree or from plant to plant only when they are upon wood which is to grow again, or when they are young and free-moving. In other words the adults or fixed Scale Insects can not possibly be scraped loose from the bark of the tree and fix themselves on any other tree and live. This shows that the precaution of burning trimmings from infested trees is not so imperative with Scale Insects as with trees infected with diseases, such as Pear Blight and Plum Knot in which the germs would remain virulent in the branches if dropped on the ground and permitted to remain there. In plain words, the trimmings of diseased or infected trees should be burned at once and the knife sterilized occasionally to prevent carrying the infection, but the case is different with trees infested with Scale insects. This is not infection but infestation. Infested trees are those attacked by insects. Branches infested with those Scale Insects which do not lay eggs do not necessarily need to be burned at the time of trimming, as the pests will die soon if the branches are cut off and their supply of food is no longer available.

In this connection it must be said that Scale Insects are not carried alive upon ripe fruit nor spread from such fruit to trees or plants where they would live. Such a thing is impossible, as we have demonstrated with careful experiments running through several seasons.

When a Scale Insect fixes upon clean fruit it is doomed, as it can never free itself again. Thus the laws of Oregon and Germany, demanding the destruction of infested fruits, are unjust both to shippers and consumers, and are based upon ignorance of the facts of the case.

When Coccids are first hatched or born they are in their most delicate condition and then most easily injured or killed by insecticides. Since they are sucking insects, and do not eat or chew the tissue of the plant, they must be killed only by contact insecticides. Internal poisons, such as Paris Green, would not affect them, because these do not kill insects that do not swallow the parts of the plant to which they are applied. The Bordeaux Mixture is not an insecticide but a fungicide, and is consequently not to be recommended for insects of any kind. For young Coccids of all species the contact insecticides will be found very useful and can be used so mild or dilute that the host plant will not be injured by the application of the same. While the insects are young and in their free-moving stage they are not yet covered by their waxy water-proof protecting coats, and are consequently to be killed by such dilute substances as Whale Oil Soap, one pound in six gallons of water,

or Soft Soap, one pound in four gallons of water, or Ivory or Common Laundry Soap, one pound dissolved in three or four gallons of water, or Kerosene Emulsion, about eight per cent. or Tobacco Decoction, one pound in two gallons of water, or more or less mild fumigation with Tobacco Smoke, Sulphur Fumes, Hydrocyanic Acid Gas or Carbon Bisulfid. While the insects are young and delicate these substances can be used in such mild proportions that the growing plants upon which they occur will not be injured, but after the pests become mature they are protected by their waxy woolly or scale-like waterproof covering, are not to be killed by any contact insecticide that will not at the same time seriously injure or destroy the green leaves of the plants upon which they occur. This explains why young Scale Insects and Plant Lice can be killed by the application of mild insecticides during the summer time without injury to the plant, but for the adult or fixed Scale Insects the sprayer must necessarily wait until the dormant period of the plants, and then treat the pests by spraying or washing thoroughly with some strong contact insecticide that will kill it but not injure the tree or plant upon which it is to be found.

This also explains why it is very important to watch most closely and carefully those species of Scale Insects that lay eggs and consequently hatch at one time, and apply a mild contact insecticide for them at exactly the proper time, or while the young are yet free-moving, delicate and unprotected. As the adults of those species which lay eggs die at the time the eggs are laid, and the life of the insect is continued only in the form of the living young at the time of the hatching of the egg, it can be seen that by thoro and proper application of the proper insecticide practically all of the brood, and consequently all specimens of the species found upon the tree or in the orchard at a certain time, can be killed at that particular time by spraying or fumigating. However, this also explains why those species of Scale Insects which bear living young, like the San José Scale, and do not die, but continue this method of reproduction for weeks, can not all be killed at one time by spraying or fumigating with sufficiently mild insecticides to kill the young only. The adult or mature pests of those species which bear living young, such as the San José Scale, will continue to live after contact applications have been made that are strong enough to kill their young on the same twigs as themselves, or even injure the foliage of the tree. The practical bearing of these points in the application of remedies for such insects is of exceeding importance.

Enemies.

There are many enemies of Scale Insects, which however are limited almost entirely to predaceous insects or internal parasites.

Among the former group are the Lady Beetles and their larvæ, the larval Lacewings and other insects, while among the latter or the internal parasites, are the minute parasitic wasps known as Chalcids, or Chalcid Flies, and Braconids. The predaceous insects feed mostly upon the very young, soft-bodied, free-moving Scale Insects, while the internal parasites attack and destroy the adults.

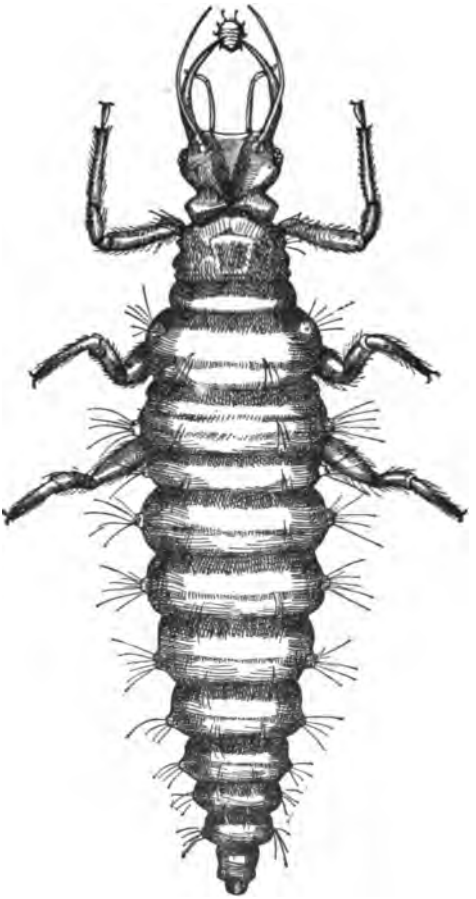


Fig. 25. An enemy of the San José Scale. Larva of the Lacewing Fly (Chrysopa sp.) killing young San José Scale. Drawn from specimen No. 6028c in the Office of the Economic Zoologist, by W. R. Walton, Artist.

We find, as a general rule, that the smaller the Scale Insect when mature or adult, the fewer the number of parasites infesting the same, and the difference of effect on the suppression is quite marked. Thus the San José Scale, being the smallest of all the Scale Insects, is too small to permit the internal parasites to find enough substance

in its body to come to maturity, and hence is rarely attacked by such beneficial creatures, if at all, while the large Turtle-shell Scale or Lecanium of the Poplar tree is so badly infested with internal parasites that its shells are often found thickly perforated with minute holes of the many parasites which have developed within each.

We have discovered and illustrated the unusual condition of the larva of a moth with insectivorous habits acting as an effective enemy of certain species of Scale Insects, belonging to the genus Lecanium, by feeding and living within the body of the insect, and there undergoing its transformation and remaining in the chrysalis.

Sub-Family I. Dactylopiinæ. The Mealy Bugs.

One group of Scale Insects known as Mealy Bugs, contains those that are covered by a white, granular, flour-like or meal-like substance, which is really a granulated waxy secretion which they have produced through pores in the skin. The little grains are arranged so closely together as to turn water from them and also protect them from their parasites and serve as a covering against sudden changes of weather. Thus it practically takes the place of the scale or covering and may be regarded as the scale in the beginning of its formation, where the wax has not yet been consolidated into one piece. These Mealy Bugs are found as very common pests upon the Coleus plant and other plants of greenhouses, and are quite too well known by lovers of potted plants. They are killed easily by spraying or sprinkling with soapy solutions or by dipping the infested plants into a weak Kerosene Emulsion, Kainit, or Muriate of Potash, dissolved in water at the rate of one ounce to a quart of water, has been found effective in killing these pests by dipping the entire infested plant into the solution. Tobacco Decoction, made by steeping one pound of Tobacco in a gallon of water for two hours, is also effective and will not injure the plants. This may either be sprayed over the plants or they may be dipped into it. The same treatment may be given with a solution of insect powder, using one ounce in two quarts of water. If many plants are to be treated Kerosene Emulsion may prove best and cheapest to use, making it about eight per cent.

Upon oak trees gall-like forms are to be found, often upon the stems or leaves. While some of these are true galls or vegetable growths, produced by insects stinging them and living within them, many are also scale insects, belonging to the genus Kermes. The resemblance of these Scale Insects to Plant Galls is very striking.

Upon Elm trees in this State is often found a peculiar Mealy Bug, belonging to the genus Gossyparia. This has the effect of stunt-

ing the growth of the tree, turning the leaves yellow, and causing them to drop prematurely. It sometimes covers the under sides of the branches until they look almost as white as though whitewashed. Spraying with eight or ten per cent. Kerosene Emulsion, or Whale Oil Soap Solution will destroy them.

Sub-family II. Coccinæ. The Soft Scales or Turtle-shell Scales.

Belonging to the Sub-family Coccinæ are peculiar Scale Insects covered with a greater or less amount of white waxy secretion, making some of them look as though they had an immense amount of wool attached, although these are not to be mistaken for the Woolly Aphids, so common upon injured places of apple trees. One species, belonging to the genus Pulvinaria, known as the Cottony Maple Scale, is very common indeed upon Maple trees grown as shade trees along streets, and many also infest Grape vines and other plants. Within its large cottony sack immense numbers of small eggs may be found, and consequently the scientific name of Pulvinaria innumerabilis is given to it. These pests often cover the twigs of trees to such an extent as to give the appearance that has been described as "popcorn on a stick." They are to be destroyed by spraying abundantly with either Kerosene Emulsion or Whale Oil Soap, one pound in six gallons of water. The soap solution enters the cottony mass and kills either the eggs or the young Scale Insects as they come through it after hatching.

There are an immense number of species of insects belonging to this Sub-family found in different parts of the earth, but their habits are more or less similar and the remedies are practically the same. It is one of the representatives of this Family, known as the Cottony Cushion Scale (Icerya) that was so very destructive in California but was effectively suppressed by the successful introduction of the Australian Lady Bird or Lady Beetle, which fed upon it and controlled it.

This is the most remarkable case of insect control by the introduction of the enemy of the pest that the world has ever known. Its success was so marked that it gave rise to great hopes of being able to control nearly all destructive insects apprehending and introducing their pests. This, however, has not been so marked for the treatment of any other known species. Reports are occassionally circulated to the effect that the San José Scale is being reduced by means of its natural enemies, but upon careful inspection, satisfactory proof can not be found for such reports.

Belonging to the Sub-family Coccinæ are the Turtle-shell Scale Insects, sometimes called Soft Scales and Terrapin Scales. These mostly belong to the genus Lecanium. They are mostly known to hor-

ticulturists, nurserymen and gardeners as Soft Scales. This is because the insect does not appear to be covered by a hard distinct shell as are some of the Scale Insects, but its skin is thickened and forms its shell, which is not readily separable from the body. Thus while it is possible to lift off the scale of most species discussed in the following Sub-family it is not possible to do this with the Soft or Turtle-shell Scale, because the hard covering is a portion of the body of the insect.

The Lecanium is one of the very serious enemies of peach and plum, especially from the central to the northern parts of Pennsylvania. It is often to be found covering the under sides of twigs and branches, and sometimes the leaves, to such an extent that it is impossible to put one's finger on the tree without at the same time touching these pests. Fortunately, where they are this numerous, their enemies often develop in considerable numbers and check them, but it is not safe to rely upon Nature to furnish control for such pests. They are large and conspicuous, hemispherical in shape and elliptical or circular in horizontal outline. Two or three species are known to attack the peach and plum, and a different species is also known upon plants in greenhouses and conservatories.

Orange, olive and lemon plants are especially liable to infestation by them.

A peculiarity in the life history of the Turtle-shell Scale Insects (genus Lecanium) is the fact that their young appear in late summer and are then dark-colored or reddish brown, flat and free-moving, but soon fix and feed to some extent and start their development, but remain exposed, often not one-fourth grown, upon the bare twigs during the severe winter weather. On tulip poplar trees, and the magnolia tree, the young of the large Magnolia Lecanium can thus be found at this time of year, while the large scales are dead, either by having completed their natural course of their life or by having been killed by parasites which have perforated their backs until they sometimes look like the lids of pepper boxes. Also upon the twigs of peach and plum trees at this time of year the young individuals of the Peach Lecanium are to be found. It is advisable to spray for them with the Lime-sulfur Wash in the fall of the year, as soon as practical after the leaves drop. It appears that for the Lecanium, the spring spraying as for the San José Scale, has not proven always as effective or satisfactory as has the same treatment for the last-named pest. However, we know where orchards in this State have been practically cleaned of the Soft-shell Scale by spraying with the Lime-sulfur Wash in the fall, and in some other orchards the pests have been killed by spring spraying with the same. The mixture is to be made and applied as directed

for the San José Scale in our October Bulletin, viz: 17 pounds of Sulphur, and 22 pounds of Lime, boiled one hour, and water added to make the solution up to 50 gallons, and thoroly sprayed over the trees, by two coats. Oils and soap solutions have not been wholly satisfactory for this particular Scale Insect and we do not recommend them for it. Of course, the remedy that is to be applied for this pest is also the one that is proper for the San José Scale, and in the spring of the year, before the bursting of the buds, is the time for spraying with the same material to prevent Peach-leaf Curl.

Trees that are infested with these Scale Insects may appear dwarfed, the leaves turn yellow and drop prematurely or become blackened as by a coating of soot. This black substance is a fungus which develops on the leaves or twigs beneath the Scale Insects where a sweet liquid has dropped from the pests, and is known as honey dew. To procure this liquid ants are generally seen climbing and descending the infested tree, and sometimes flies, bees and hornets hum around the tree thus infested to such an extent that their noise resembles that made by bees in swarming. Thus some Scale Insects produce honey dew which is sought by ants and winged insects the same as the honey dew produced by plant lice. There is, of course, no need of taking steps to prevent the ants from climbing the trees, as the proper course is spraying for the Scale Insects, and when they are destroyed the journeys of the ants will cease. Also it is not necessary to spray the leaves with a fungicide for the black fungus that develops upon them, but spray the tree at the proper time with an insecticide to destroy the Scale Insects.

The most of our Lecaniums are oviparous or egg-laying, the female leaving the eggs beneath her scale-like body and letting them there remain until they hatch, when the young, flat, elliptical dark-brown insects crawl forth and fix themselves upon the twigs and remain through the fall and winter undeveloped. It is evident that in Pennsylvania there is but one period or generation per year of any species of the genus Lecanium. The males appear in the summer, not a great while after the hatching of the eggs. Late summer applications of mild contact insecticides, such as one pound of Whale Oil Soap in six gallons of water, or eight per cent. Kerosene Emulsion, used thoroly as sprays, are recommended as excellent insecticides for such Scale. Those species of Insects of which the adults die and only the delicate young remain as the entire brood at a certain time, can be controlled by the fruit grower if he will watch the time of hatching of such pests and spray them just after they have hatched. However, if it should not be suitable to spray at such time he can also have recourse in the fall and spring spraying as for other scale insects.

Sub-family III. Diaspinæ. Armored Scale Insects.

One characteristic feature of the Scale Insects belonging to the Sub-family Diaspinæ, and known as the Armored Scale Insects, is that the body of the insect is covered with a scale, composed in part of the moulted skins and partly of a waxy secretion of the insect. This secretion comes through the pores of the skin and finally hardens into a scale which covers the very soft and delicate body and is practically free from the same after it has once formed. Thus the scale or covering of such insects can be removed leaving the insect natural and uninjured upon the place where it has been fixed.

In the Annual Report of the U. S. Department of Agriculture for 1880, Prof. Comstock has so well described the metamorphosis or transformation of the insects of this Sub-family that we can do no better than to quote the same.

"The newly-hatched scale-insect is oval in outline, much flattened, furnished with six legs, a pair of antennæ, and an apparatus for sucking the juices from plants. At this stage of its existence it is very small, a mere speck, which the untrained eye could only with difficulty detect. By means of a lens, however, these minute creatures can be seen crawling in all directions over the leaves or bark of an infested tree. After wandering for a time, usually but a few hours or even less, the young scale-insect settles on some part of the plant, inserts its beak, and drawing its nourishment from the plant, begins its growth at the expense of its host. In a short time there begins to exude from the body of the larva fine threads of wax, which are cottony in appearance. The excretion of this wax continues until the insect is completely covered by it. The rate at which this excretion is produced varies greatly. Thus larvæ of the red scale of Florida (*Aspidiotus ficus*), which were only one day old, were found to be completely covered by the cottony mass which they had excreted; while the larvæ of Glover's scale (*Mytilaspis Gloverii*) did not become entirely covered until they were six days old. Sooner or later the larvæ begins to excrete a pellicle, which, although very thin, is dense and firm in texture. The mass of cottony fibres either melts or is blown away, or, as in certain species of Aspidiotus, a portion remains as a white dot or ring in the centre of the scale. After a period, which, in several species that we have studied, is about one-half of the time from the hatching of the larva to the emerging of the male, or one-third of the time from the birth of the female to the date at which she begins ovipositing, the larva sheds its skin. In some species this does not take place until after the beginning of the formation of the permanent scale, and in such cases the moulted skin adheres to the inner surface of the scale; and cannot be seen while it is in its normal position on the plant. This

is true of many species belonging to the genus Aspidiotus (*A. ficus*, *A. Citri*, *A. perniciosus* and others). In these species the position of the exuviæ is indicated by a nipple-like prominence, often marked by a white ring or dot, which is the remains of the cottony mass first excreted. In these, the larval skin is plainly visible either upon the surface of the scale, as in certain species of Aspidiotus (*A. nerii*), and in Diaspis, or at one extremity, as in Mytilaspis. Sometimes, however, the larval skin is covered by a delicate transparent layer, which, I think, is the melted or compacted remains of the cottony mass excreted by the young larva.

The change which the larva undergoes at this moult is a very remarkable one, appearing to be a retrogression, instead of an advancement to a more highly organized form, as is the rule in the development of animals. With the skin are shed the legs and antennæ. The young scale-insect thus becomes a degraded grub-like creature, with no organs of locomotion. The mouthparts remain, however, in a highly developed state and are well fitted to perform their functions. This apparatus is not the least remarkable thing in the structure of these insects. It is terminated by a thread-like organ, which is frequently much longer than the body of the insect, and is composed of four delicate hair-like bristles. By means of this organ the insect is firmly attached to the plant, and draws its nourishment therefrom. From this stage the development of the sexes differs.

The second and last moult of the female takes place, in those species which we have studied most carefully, when she is about twice as old as when the first moult occurred. The change in appearance of this moult presents nothing remarkable. The second cast skin is joined to the first, and with it forms a part of the scale which covers the body of the insect. Sometimes, as in the genus Uhleria, this moulted skin is very large and constitutes the greater part of the scale, the greater part of it being excreted subsequently to the second moult. Soon after the second moult of the females takes place the adult males emerge, and doubtless the impregnation of the females occurs at once. After this, the body of the female increases in size, becoming distended with eggs. The oviposition takes place gradually, and in those species that we have studied, begins when the female is about three times as old as when the first moult occurred. The eggs are deposited beneath the scale, the body of the female gradually shrinking and thus making room for them. Some species, however, are viviparous.

The male scale-insect during the early part of is larval life is indistinguishable from the female. The first moult occurs at the same time and is accompanied by a similar change, the male larva,

like the female, losing its legs and antennæ. The second moult is also synchronous with the second moult of the female; but here the similarity in form between the two sexes ceases. Even before this moult takes place there may be observed the formation of rudimentary limbs beneath the transparent memberless skin of the larva; after this skin is shed, the male, now in pupa state, differs remarkably from the female. The male pupa has long antennæ, and its legs and wings, although in a rudimentary state, are very large. The duration of the pupa state in those species which we have bred, is short, lasting but a few days; and then, after a third casting of the skin, the adult male appears.

Plate XXVI, A represents the insect in this stage. The anterior wings, though very delicate, are large, and enable the male to fly readily. The posterior wings are represented only by a pair of halteres. These insects resemble in this respect the flies, gnats, and other insects belonging to the order of Diptera, or two-winged insects. The posterior end of the body is furnished with a style, which is sometimes nearly as long as the remainder of the body, and is the external organ of reproduction. As our figures represent only a dorsal view, the most remarkable character of the adult—the supplementary eyes which take the place of the mouthparts—is not shown."

While for the determination of the species of any Scale Insect it is necessary to use a compound microscope and critically examine minute details of structure, it is possibe to recognize the genera or major groups by a study of the external form of the shell with an ordinary hand lens. For this purpose a microscope with a power of at least ten diameters should be used, and the observer should be careful to place himself in such position as to receive the best possible light, falling over his shoulder and rendering the conditions favorable for careful examination.

A few of the genera of Armored Scales common in this State are as follows:

Aspidiotus.—This is the genus to which the Round-armored Scales belong, and of which the much dreaded and destructive San José Scale is a typical representative. There are over two dozen species known in the United States, many of which infest oranges, and other citrus fruits, others attack greenhouse plants, and others prove injurious to deciduous trees. The San José Scale, known as Aspidiotus perniciosus, has been described in detail in our previous Bulletins from this office, and for details as to food plants, life history and remedies the reader is referred to our October Bulletin. The San José Scale is distinguished by its strictly circular outline, the little point or tip in the centre, with a groove or disk around

the same. Other species do not have the groove around the central tip, or do not have this in the exact middle of the scale.

The European Fruit Scale is often found in Pennsylvania, especially upon cherry and plum trees, and is sometimes taken for the San José Scale. However, it is distinguished by its outline being elongate and slightly wider at one end, with the highest point toward one side. From the fact that specimens received at this office have been in a uniform stage of development, with all the adults dead and falling away at one time, as does the Lecanium after dying, we have reason to think that this species multiplies by laying eggs, which hatch in a brood, instead of bearing living young in continued succession, as does the San José Scale.

The numerous Scale Insects to be found upon greenhouse plants and potted plants are to be killed by one of the following means:

(1) Spray or wash with a strong Tobacco Decoction, made by steeping a pound of Tobacco in a gallon of water for two hours.

(2) Hold the infested plant in the steam of a teakettle at such distance as will be the extreme temperature that can be endured by the human hand.

(3) Dip the plant upside down into a tub of water as hot as the hand can endure.

(4) Fumigate with Tobacco Smoke.

(5) Fumigate with Carbon Bisulfid.

(6) Make a solution of Ivory Soap in water, using one pound in four gallons of water, add a few tablespoonsful of Ammonia to this, and spray the plants with it or dip them into it, or wash the infested plants with a sponge dipped into such solution. We recommend No. 5 as the best and most conveniently applied of the remedies here cited.

The genus Diaspis is commonly represented in this State by the Rose Scale, and is found as a snowy white scale commonly seen upon rose bushes, raspberries and blackberries. It is to be treated the same as the San José Scale, with the Lime-sulfur Wash in the fall or spring, or with milder contact insecticides during the summer. It should be understood that these pests do not generally spread to other varieties or kinds of plants, and there is no need to fear the spread to fruit trees of such an insect as the Rose Scale. Some of them, such as this species, may be decidedly limited in the range of their feeding, while others, such as the San José Scale, may occur upon any one of a great many different kinds of plants.

Chionaspis is the name of the genus to which the common Scurfy Scale or White Scale belongs. Our common Scurfy Scale on apple and pear is known by the scientific name of *Chionaspis furfurus*. The common name of this scale is given because it looks like a

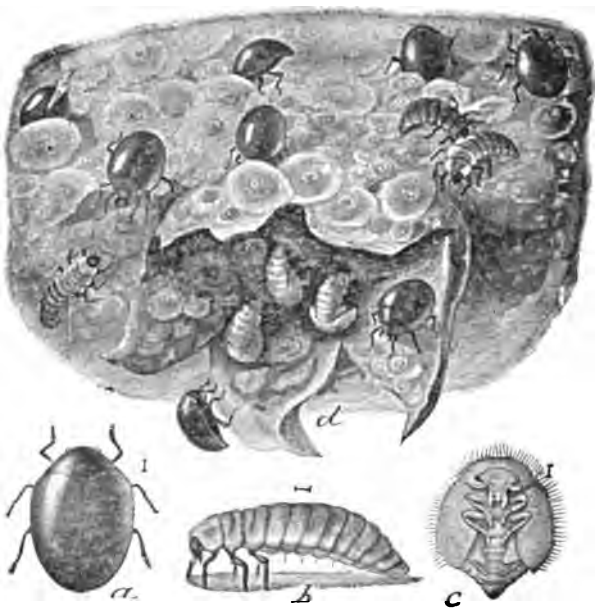


PLATE XXII.

Fig. A. Lady Beetles (*Pentilia misella*) devouring San José Scale. By Howard, in Bulletin No. 3. Technical Series, Division of Entomology, U. S. Department of Agriculture. Loaned by U. S. Department of Agriculture, Washington, D. C.

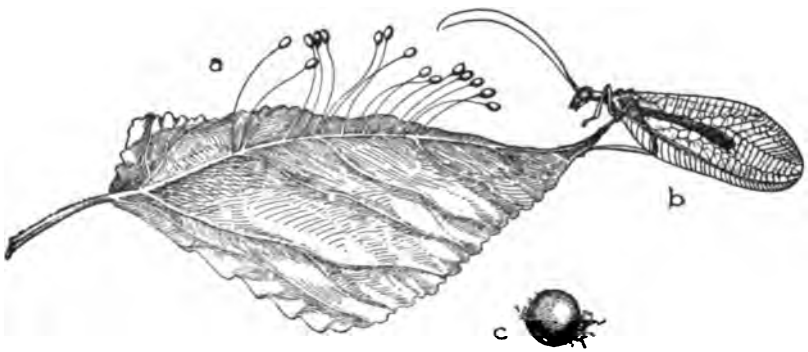


Fig. B. Lace-wing (*Chrysopa oculata*); (a) eggs on egg-stalks; (b) adult; (c) cocoon, enlarged 2 diameters. Drawn in the office of the Economic Zoologist by W. R. Walton. Specimens sent by the Zoological Society of Philadelphia.

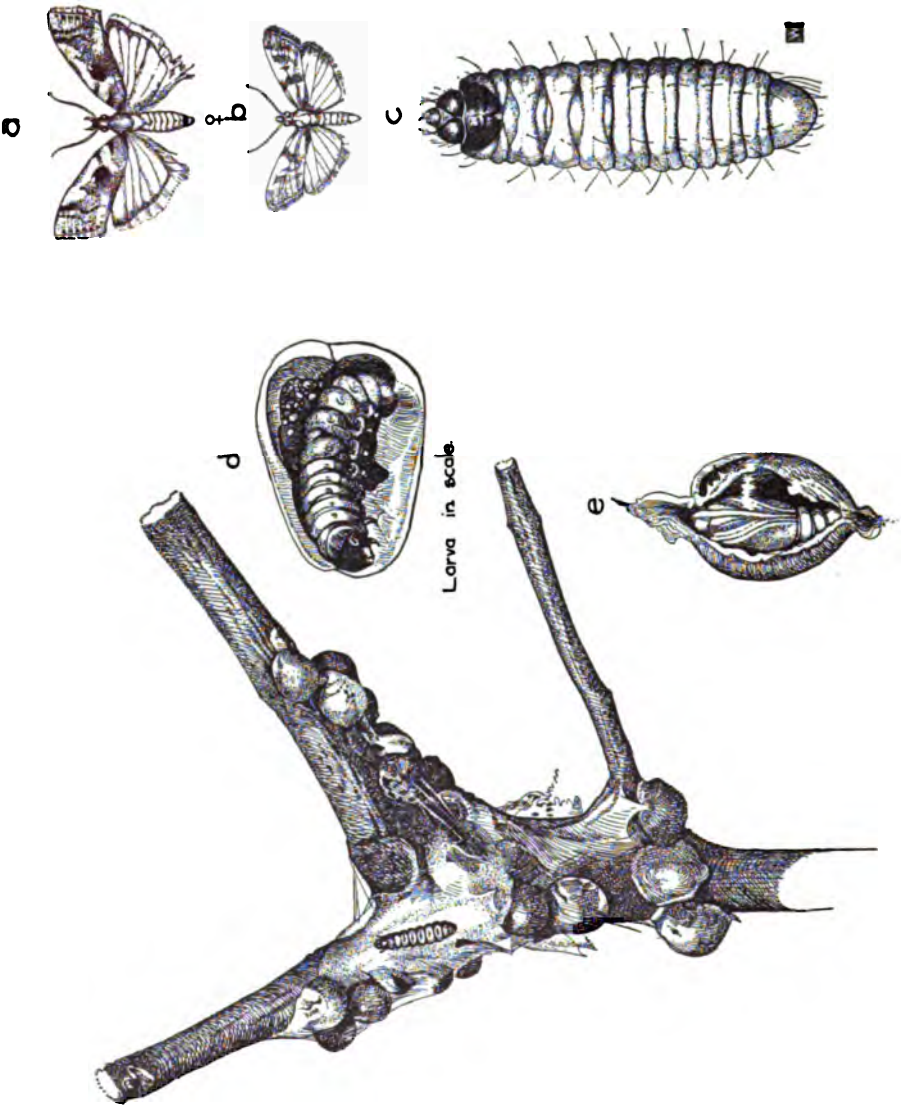


PLATE XXIII.

Moth Larvæ (*Lætilia coccidivora*) destroying Turtle-shell Scale (*Eulecanium tulipifera*) on Magnolia tree. (a) female, enlarged four diameters. (b) male, enlarged four diameters. (c) larva, enlarged ten diameters. (d) larva feeding within scale, enlarged seven diameters. (e) pupa within scale, enlarged five diameters. Drawn from Nature in the Office of the Economic Zoologist, by W. R. Walton.

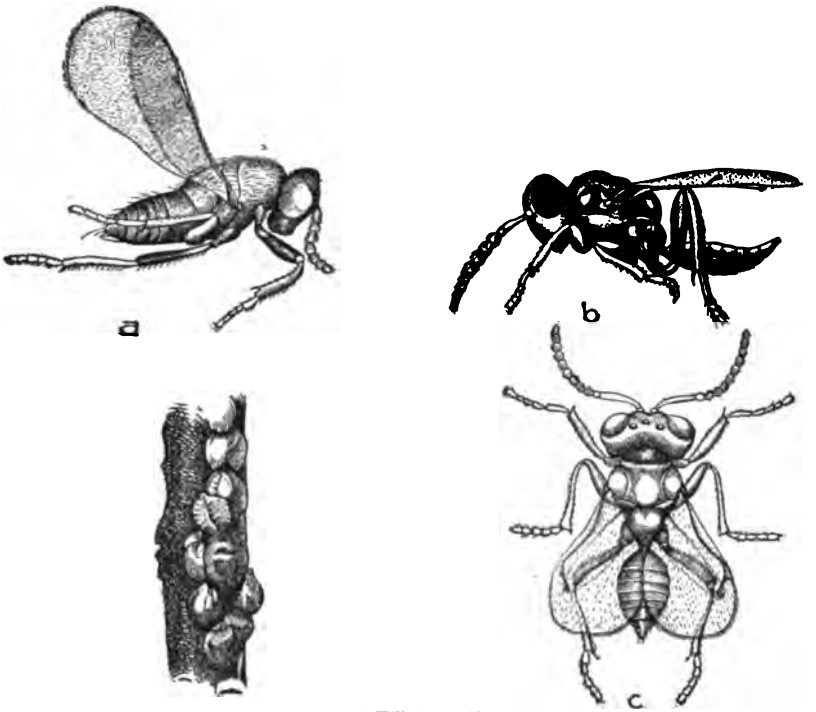
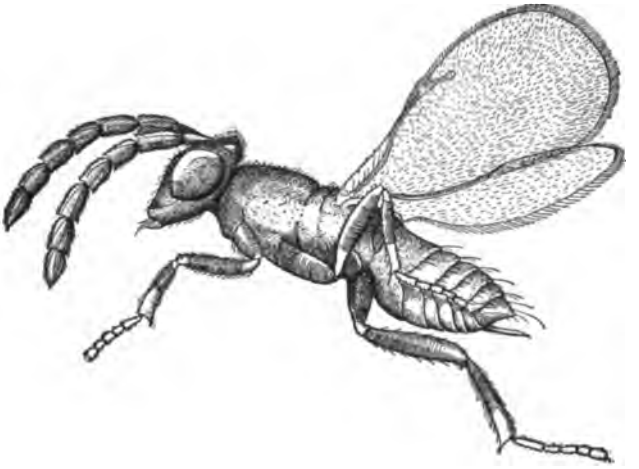


PLATE XXIV.

A. Lecanium sp. on Mulberry, slightly enlarged. Fig. a. *Coccophagus immaculatus* Howard, enlarged 30 diameters; b and c, *Pachyneuron micans* Howard, enlarged 30 diameters; Chalcid parasites bred from Lecanium. Drawn in the Office of the Economic Zoologist by W. R. Walton. Specimens sent by Mr. F. G. Stokes, of Philadelphia.



B (*Phycus varicornis* Howard) Chalcid Parasite of Scurfy Scale of Pine, enlarged 65 diameters. Drawn in the Office of the Economic Zoologist, by W. R. Walton.

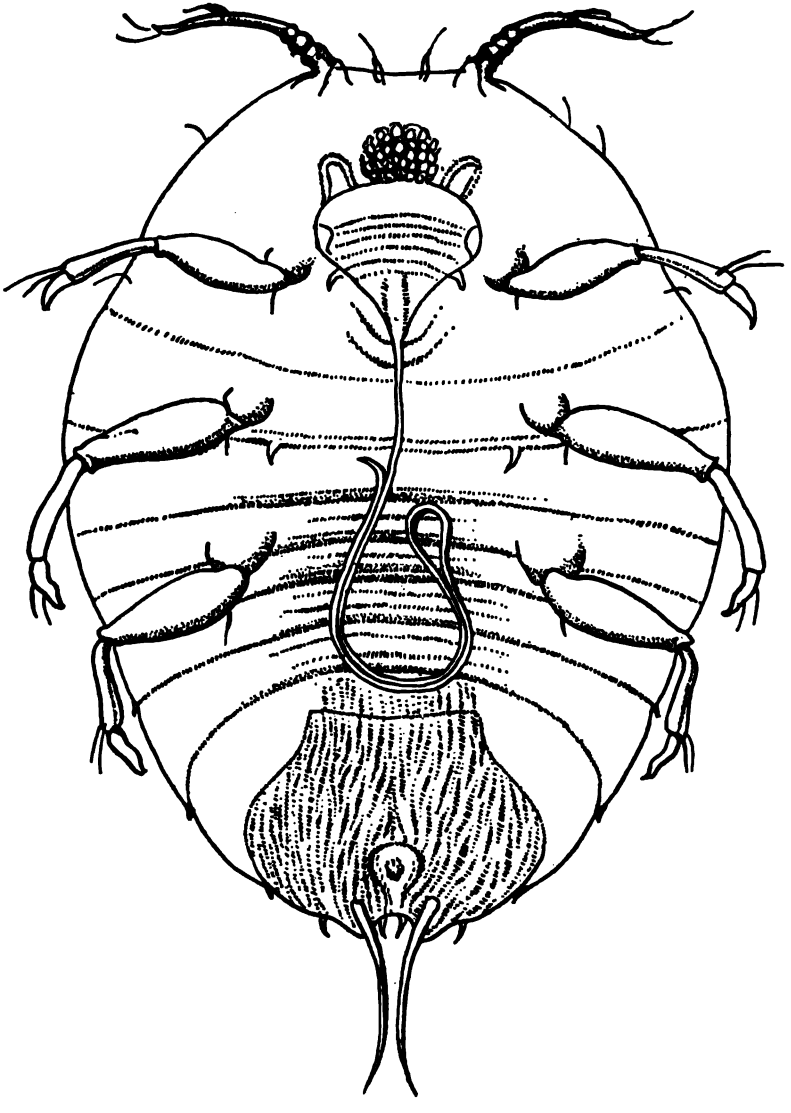


PLATE XXV.

Under side of young San José Scale, very greatly enlarged, showing the very long proboscis like a whip-lash. Drawn from Nature by W. R. Walton in the Office of the Economic Zoologist.

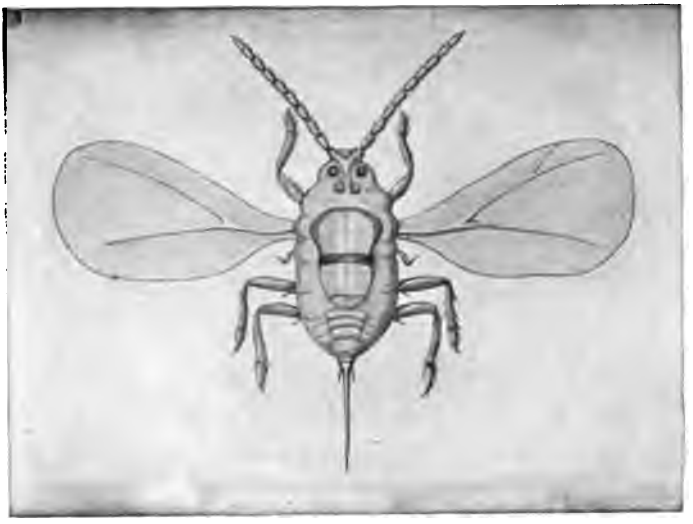


PLATE XXVI.

A. Male San José Scale, greatly enlarged. Drawn by W. R. Walton, Artist, in the Office of the Economic Zoologist, Harrisburg, Pa.

B. Rose Scale (*Diaspis rosæ*) on raspberry. A scale insect quite different from the others previously discussed in these Bulletins, which attacks rose, raspberry, etc., and is to be killed by the same remedies as for the San José Scale. Photographed in the Office of the Economic Zoologist. Natural size.

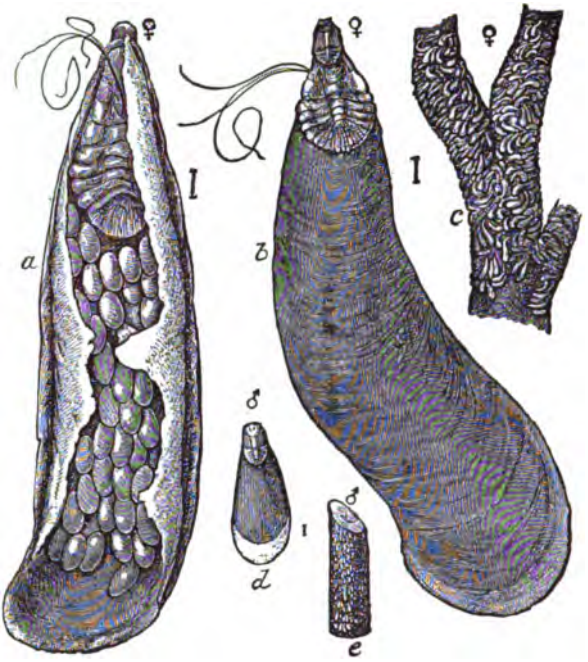


PLATE XXVII.

Fig. 1. Oyster-shell Scale (*Mytilaspis pomorum*) a. Under side of female scale, showing eggs as seen during Winter and Spring; b, upper side of same; c, female scales, natural size, as seen on badly infested branch; d, male scales; e, branch covered with male scales. c and e are natural size, and a, b, and d are greatly enlarged. The straight lines at right of a and b indicate their natural size. (From Howard, in Yearbook of U. S. Dept, of Agr.)

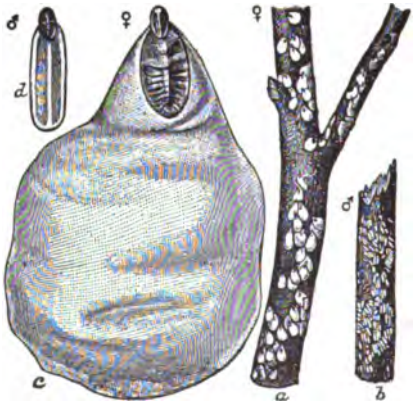
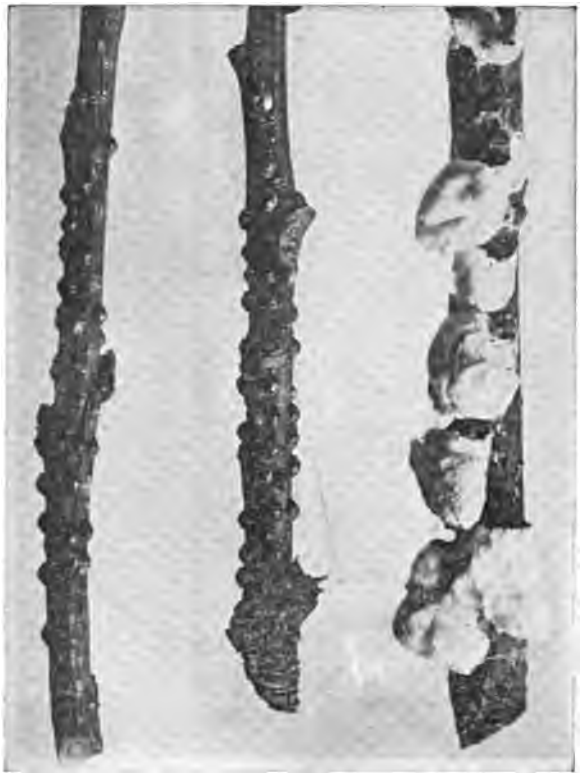


Fig. 2. Scurfy Scale (*Chionaspis furfurus*) ; a, female, and b, male on twigs, natural size; c, female scale, upper view, much enlarged; d, male enlarged. (From Howard, in Yearbook of U. S. Dept. of Agr.)



a b c

PLATE XXVIII.

a. Lecanium or Turtle-shell Scale on Maple. b. Lecanium or Turtle-shell (Soft Scale) on Plum. c. Cottony Maple Scale. All natural size. Photographed in the Office of the Economic Zoologist.

PLATE XXIX.

a. Scurfy Scale. Small specks, males; large ones, females. b. Scurfy Scale. All females, adult. C. Oyster-shell Scales. All natural size. Photographed in the Office of the Economic Zoologist.

blotch of scurf or dandruff fallen upon a limb. This insect reproduces by laying eggs, and produces two generations per year. The first lot of eggs hatches about the 20th of May, at an average date in this State, and the young insects, which are dark red in color, crawl about for a day or two, then fix themselves and complete their development and lay eggs which hatch during the month of August. The insects from this brood complete their development before winter and lay eggs and die. The two sexes of Scurfy Scale are well marked and easily distinguished. The females are fanshaped and large enough to be distinguished readily by the unaided eye, while the males are but narrow white blotches, often crowded together in numbers upon some parts of the branch where the females are not found so abundantly. During the winter time if the larger or female scales be raised and examined, from twenty to thirty dark red eggs will be found beneath them. The eggs and young of this genus can always be known by the dark red color, as can also the bodies of the parents.

Mytilaspis is the genus to which the Oyster-shell Scale belongs. These are sometimes called Bark Lice, Oyster-Shell Bark Lice, etc. The species most commonly found in this State upon apple, pear and plum is known by the scientific name *Mytilaspis pomorum*. There are different species of this genus, one being found upon the orange and commonly sent to us upon the skin of oranges imported as food. The latter is known as *M. Gloverii*. It is recognized by the narrow form of the scale, slightly smaller size and less curving than the Apple Tree oyster shell. The Oyster-shell Scales are so called because of their general resemblance to the shell of an oyster. They are hard, elevated, a variable brown in color and conspicuous. They are found upon most lilac bushes, and in fact these are the chief enemies of the lilac. The males are distinguished by their smaller size and less curvature of shell.

In Pennsylvania there are two broods of the Oyster-shell Scale per year, the same as with the Scurfy Scale. However, these hatch a little earlier than the Scurfy, as the first brood of the Oyster-shell appears in this State on the average, about the 10th of May, and the second brood during the early part of August. The young Oyster-shell Scale Insects are milky white or pearly white in color, and the bodies of the insects beneath their scales and the eggs of this genus are also the same color. In the fall of the year the female lays her eggs beneath the shell, and her body gradually shrivels and dies, leaving the eggs to occupy the greater portion of the space that had formerly been taken by the living body, the same as with the flatter and whiter Scurfy Scale. If during the fall, winter or early spring, the shell of the Oyster-shell Scale be lifted, there will

be found beneath it from thirty to forty milk white eggs, snugly arranged in rows. When these hatch, about the second week of May, is the time to apply mild contact insecticides to destroy them. However, they can also be killed by spraying with the Lime-surfur Wash in the same manner and at the same time as has been recommended for the San José Scale.

We have received reports of badly infested orchards being freed from the Oyster-shell Scale by spraying. A remarkable case was that of Hon. H. E. Little, the late Secretary of the Wyoming County Horticultural Society, of Tunkhannock, Pa., in whose orchard we gave a demonstration in the latter part of November, showing the method of preparing and applying the Lime-surfur Wash for the San José Scale. Some of his trees were badly infested with the last-named pests, and others were badly injured by the Oyster-shell Scale, the bark being in fact entirely covered, while others had both pests upon them. A year after the application Mr. Little came personally to report to us that the spraying had entirely cleaned the bark of his trees, and on many he could find no living pests whatever of either species, and that very few living San José Scale or Oyster-shell Scale remained in the entire orchard. This is a remarkable case of almost eradicating two species of destructive Scale Insects by one fall spraying alone, and that upon apple trees, where it is generally supposed to be more difficult to kill the Scale Insects than upon peach trees.

The Oyster-shell Scale is found very abundant upon apple, pear, plum, poplar, willow, lilac, soft maple and ash trees in the central and northern portions of Pennsylvania, and is sometimes so abundant upon maple, poplar and apple trees as to prove destructive to them. In regions where the San José Scale has not yet occurred in abundance, the Oyster-shell Scale may be the chief of the Scale Insects needing attention.

Poplar and soft maple trees planted for shade along streets or for other purposes are often seriously infested by the Oyster-shell Scale. A forest of South Carolina poplar trees was planted by the Tyrone Paper Company, on a hillside overlooking Tyrone, Pennsylvania, and was soon found to be badly infested by this pest. We recommended spraying with Kerosene Mixture, using about ten per cent. Kerosene. This was done with care about the first of August, and being applied at about the time the second brood was hatching, it was very successful and resulted in cleaning up and saving a large grove of badly infested trees. The chief point of this work was the time of the year in making the application of the dilute insecticide. The foliage of the trees was, of course, not injured.

It will be noted that in the above description of Scale Insects we have referred to the distinguishing color of eggs and young. We believe it possible to determine the genera of the common Scale Insects by these colors alone. For example, the young of the San José Scale, and also the body of the adult as when found alive under the shell, is exactly the color of sulfur or a ripe lemon; the eggs and young of the Rose Scale are pink; the eggs and young of the Scurfy Scale are dark red or turkey red; the eggs and young of the Oyster-shell Scales are milky white. The bodies of the adult scales when alive and in thriving condition and found beneath their protecting scales are practically the same color as their eggs or young. This is an important criterion in aiding to determine whether or not the insect is dead.

Many persons who apply insecticides wish to know if these have been effective in killing Scale Insects. From an external examination of the protecting scale alone, it is entirely impossible to tell if the pests have been killed by any application that may have been made to them. It is possible where the pests are numerous to rub a knife blade or some blunt firm instrument over them with great pressure, and if an oily juice can be pressed out, the operator is safe in inferring that the insects are yet alive, but if they be so dry that no liquid can be pressed out of them, they are no doubt dead. However, the correct and safe method of determining whether the Scale Insects be alive or dead is to lift the protecting scale and examine the body with a microscope. If it be shriveled, shrunken or discolored, it is dead; but if plump, full and juicy and possesses its normal color, as described above, it is alive.

We desire to make a further study of the Scale Insects of Pennsylvania with a view toward publishing detailed dates of appearance, stages, food plants, and enemies of the same, and cordially invite persons interested to aid these studies by sending us specimens by mail. They will be named free of charge, with both common and scientific names, and literature will be sent free concerning them. In mailing such specimens to us the contributor should kindly give the date, locality, and name of collector, as well as the food plant on which they are found, and wrap the specimens in soft paper, but not in cotton. Place the name of the sender on the package and mail it to H. A. Surface, State Zoologist, Harrisburg, Pa.

THE SAN JOSE SCALE REMEDIES.

(Concluded from the October Bulletin.)

III. SOAP SOLUTIONS.

Soap solutions can be made to kill San José Scale if used strong enough, but it requires a greater proportion of soap than most people think necessary. To dissolve the soap use hot water.

(h) Whale Oil Soap.

Whale Oil Soap is a good insecticide when used in the proper strength and at the right time. During the summer while trees are in leaf it can be applied, dissolved in water, at a strength of one pound in five or six gallons, to destroy young scale insects and all kinds of plant lice. It is valuable for holding San José Scale in check during the summer, as it will do this without injuring the foliage, and is cheaper and more efficient than most of the commercial preparations that are given special "trade" names. During the time when the leaves are off the trees it should be applied at a much greater strength in order to kill off the older San José Scale. That which has been found most effective has been two pounds of Whale Oil Soap dissolved in one gallon of hot water and applied either as a wash or as a spray. This can be used with safety to the trees at a strength sufficient to kill the pest at any time when the leaves are off, although some persons claim that a fall application will injure the fruit buds and that the only proper time to apply a strong solution of Whale Oil Soap, in order to kill the scale and at the same time not injure the buds, is in the spring just before the leaves appear. We are conducting experiments with this at present and hope to report on them again next spring.

(i) Soft Soap, Laundry Soap, Etc.

Good old-fashioned country soft soap can be used to kill the Scale without injury to the trees by making it as thick as house paint and applying it with a brush or sprayer at any time when there are no green leaves to be injured by it. The chief point is to be careful to cover all the bark from the tip of the furthest twig to the base of the tree. Equal parts of soft soap and warm water will do the work. Common laundry soap, shaved fine and dropped into hot water, made into a strong solution, using at least three pounds of such soap to a gallon of water will kill the scale. Where there are only a few trees such remedies are to be recommended, but where many trees are to be treated this becomes too expensive. The strong soap solution may be applied with brushes if care be taken to cover every part.

SUMMARY OF RESULTS IN OTHER STATES.

The manufacturers and agents of commercial insecticides have so unjustly and unmercifully criticized the writer for advocating the boiled Lime-sulfur Wash as both the best and cheapest remedy for the San José Scale that he takes pleasure in publishing below extracts from various publications of the United States Government and State Experiment Stations, in which the writer gives the results the operator experienced:

The United States Department of Agriculture.—"Experiments have yielded such gratifying results that the remedy (Lime-sulfur Wash) is now widely used and recommended by the Bureau of Entomology and various experiment stations. The chief advantage which this wash seems to possess are that it is highly effective in the destruction of the San José Scale, other scale insects, plant lice, and other similar pests. It also controls to a large extent the development of certain fungous diseases such as Peach-leaf Curl." U. S. Farmers' Bulletin No. 127, page 19.

Alabama Experiment Station.—"The spray in most general use, and at present most satisfactory, is the so-called Lime-sulfur salt Spray." Bulletin 139, page 17.

Arkansas Experiment Station.—"The best remedy for the San José Scale is the so-called Lime-salt-surphur Wash." Bulletin No. 92. "Salt is now commonly deemed unnecessary. The Lime and Sulfur Wash requires thorough cooking as essential to its effectiveness against the San José Scale." Arkansas Experiment Station Bulletin No. 95, page 71.

California Experiment Station.—"Whenever it appears upon deciduous trees, winter spraying with the Lime-salt-surfur should be resorted to." Report California Experiment Station, 1901. part 1.

Colorado Experiment Station.—"This wash, when properly made. is one of the most effectual applications for the destruction of scale insects and eggs of the brown mite." Bulletin No. 114, page 37.

Connecticut Experiment Station.—"In a general way, however, Table VII shows that all of the lime and sulfur mixtures were fairly effective in destroying the scale, whether applied in fall or spring." Connecticut Agricultural Experiment Station Report for 1906, page 290.

Delaware Experiment Station.—"If the San José Scale is present and has not been practically vanquished by fall and spring spraying, then the K-L-B-P (Kerosene-Lime-Bordeaux-Poison) is by far the best spray mixture to use." Delaware Experiment Station Bulletin No. 76, page 18.

Georgia Experiment Station.—"Georgia fruit growers in many parts of the State, have, during the past few years, demonstrated beyond question the value of lime and sulfur as a remedy for the San José Scale. Hundreds of orchards that have been sprayed each winter for the past four or five years, silently testify to the value of the boiled lime and sulphur wash." Bulletin No. 21, pages 203-204.

Illinois Experiment Station.—"The cheapest and most efficient of the eleven insecticide mixtures thoroughly tested against San José Scale were the simple lime and sulfur mixtures (without salt or blue vitriol) dissolved by boiling together." Bulletin No. 107, page 260.

Purdue University Experiment Station.—"The best remedy known at the prest time is the lime-sulfur wash." Bulletin No. 118, page 417.

Iowa Experiment Station.—"It has proved very efficient against the San José Scale and it is likewise destructive to the oyster-shell scale, the scurfy scale, the case bearers and certain other insects which pass the winter in some form on the trees." Bulletin No. 89, page 18.

State Crop Pest Commission of Louisiana.—"By many years of work, however, the wash known as the lime-sulfur wash has been developed to a high point of efficiency, and is almost universally used in controlling the San José Scale in orchards." Circular No. 12, page 5.

Maryland Experiment Station.—"In view of the results recorded in this Bulletin, and the observations made in the various parts of the State, there seems to be no spray that can be recommended for the control of the San José Scale, except the lime, sulfur and salt solutions." Bulletin No. 99, page 88.

Massachusetts Experiment Station.—"A summary of the experimental treatment for the scale, made in this country, indicates that there is nothing better than the lime-sulfur where boiling is possible." Bulletin No. 116, page 22.

New Jersey Experiment Station.—"Lime, sulfur and salt, as a winter wash, maintained its standard of effectiveness on peach and plum, and did better on apple and pear than in 1903-1904." Bulletin No. 186, page 5.

New York Experiment Station.—"Winter treatment: Lime and sulfur wash. This mixture has considerable value as a fungicide. It prevents curl leaf and has in some cases prevented apple and pear scab." Bulletin No. 245, page 134.

North Carolina Experiment Station.—"The remedy which is at the present time most widely used against the San José Scale is the Lime-sulfur Wash, applied with a spray pump." Bulletin No. 5, Vol. 28, page 19.

Ohio Experiment Station.—"If San José Scale is present, spray with lime-sulfur wash. This will also prevent leaf curl." Circular No. 52, page 3.

Oregon Experiment Station.—"This wash is the most satisfactory for San José Scale and also a good fungicide." Bulletin No. 93, page 46.

South Carolina Experiment Station.—"There are several remedies which have been found effective against the scale, but the kerosene treatment is undoubtly the best and cheapest." Bulletin No. 65, Page 5.

Tennessee Experiment Station.—"The lime-sulfur wash from the standpoint of cheapness, accessibility and efficiency is the best spray now known for the San José Scale." Bulletin No. 4, page 13.

Vermont Experiment Station.—"The best known remedy at the present time is the lime-sulfur wash, which should be applied in this section in the early spring." Bulletin No. 129, pages 126-7.

Viriginia State Crop Pest Commission.—"We still recommend the Lime-sulfur Wash as the cheapest and most effective for general orchard work." Circular No. 2, New Series, page 11.

West Virginia Experiment Station.—"None of them (the commercial insecticides), however, seem to possess the fungicidal properties of the lime and sulfur sprays, but as scale killers some, at least, are entirely satisfactory and greatly simplify the matter of combating scale insects on fruit trees." Bulletin No. 107, page 353.

SPECIMENS RECEIVED DURING JULY, 1907.

Number.	Specimens.	Date—July, 1907.	Name and Address.
	Reptiles and Batrachians.		
9686	(a) Grass Snake (Liopeltis vernalis), ...		
	(b) Purple Salmander (Gyrinophyllus porphyriticus), ...	1	W. W. Long, Washington.
9687	Pilot Snake (Callopeltis obsoletus),	1	W. Gummo, Farrandsville.
9688	Common Garter Snake (Thamnophis sirtalis), ...	1	B. Geoggler, Tobyhanna.
9689	Copperhead Snake (Agkistrodon contortrix), ...	1	R. W. Wehrle, Indiana.
9702	House Snake (Lampropeltis triangulus), ...	1	J. B. Richard, Barto.
9703	Common Garter Snake, ...	1	P. S. Tooker, Easton.
9709	(a) Meadow Frog (Rana palustris), ...		
	(b) Cave Salamander (Spelerpes longicauda), ...	2	W. O. G. and H. K. West, Danville.
9710	Varied Tree Frog (Hyla versicolor), ...	2	W. Packard, Pennwyn.
9711	Pilot Snake, ...	2	J. B. Fink, Shickshinny.
9712	(a) Spotted Salamander (Amblystoma punctatum), ...	2	Mrs. S. M. Kranmer, Granville Summit.
9715	Common Water Snake (Natrix sipedon), ...	2	J. Bunnell, Farrandsville.
9716	Copperhead Snake, ...	2	J. K. West, Danville.
9732	2 Hoptoads (Bufo lentiginosus americanus), ...	2	B. Coover and R. Martin, Harrisburg.
9733	(a) 2 Common Water Snakes, ..		
	(b) 2 Painted Turtles (Chrysemys picta), ...		
	(c) Speckled Turtle (Clemmys guttatus), ...	2	C. L. Gruber, Kutztown.
	(d) Red Salamander (Spelerpes ruber), ...		
9734	(a) Pilot Snake, ...	2	R. E. Bonner, Royalton.
9743	Granite Salamander (Plethodon glutinosus), ...	3	R. W. Wherle, Indiana.
9745	Rattlesnake (Crotalus horridus), ..	3	L. Lantz, Farrandsville.
9747	Red-bellied Snake (Storeria occipitomaculata), ...	3	D. D. Bauman, Sand Patch.
9748	Ribbon Snake (Thamnophis sauritus), ...	3	E. A. Weimer, Lebanon.
9749	Ribbon Snake, ...	3	N. Phillips, Tioga.
9750	(a) Common Water Snake, ...	3	Miss C. B. Steele, Tioga.
9751	Pilot Snake, ...	3	J. C. Buxton, Independence.
9752	Copperhead Snake, ...	3	M. M. Kauffman, Clarion.
9768	Common Water Snake, ...	5	E. Burnell, Farrandsville.
9770	Blacksnake (Bascanion constrictor), ...	5	G. R. Ross, Lebanon.
9771	2 House Snakes, ...	5	A. J. Tatlow, Rydal.
9772	Copperhead Snake, ...	5	M. F. Kauffman, Clarion.
9774	Blacksnake, ...	5	S. C. Snowden, Dayton.
9790	Blacksnake, ...	6	A. S. Staggerwalt, Bowmanstown.
9792	House Snake, ...	6	A. W. Smith, Blairsville.
9793	2 Pilot Snakes, ...	6	R. W. Wherle, Indiana.
9794	(a) Common Garter Snake, ...		
	(b) Common Water Snake.		
	(c) Ring-necked Snake (Diadophis punctatus), ...	6	G. W. Gordon, Brownsville.
9801	House Snake, ...	8	L. G. Schaum, Ryeland.
9803	House Snake, ...	8	C. A. Benner, Farrandsville.
9824	Spotted Salamander, ...	9	J. M. Mossher, New Milford.
9846	Common Garter Snake, ...	10	G. Bohn, Lickdale.
9847	Ring-necked Snake, ...	10	Mrs. S. W. Kranmer, Driftwood.
9848	Bull Frog (Rana catesbeana), ...	10	——, Harrisburg.
9865	(a) 2 Sculptured Turtles (Clemmys insculptus), ...		
	(b) House Snake, ...	10	W. Angus, Stoddartsville.
9868	Pilot Snake, ...	10	H. A. Brightbill, Marsh Run.
9869	Rattlesnake, ...	10	R. Kretzing, Marsh Run.
9874	Rattlesnake, ...	11	R. L. Jackson, McConnellsburg.
9875	(a) 2 House Snakes, ...		
	(b) Common Garter Snakes, ...	11	W. Angus, Stoddartsville.
9876	Common Garter Snake, ...	11	C. A. Benner, Farrandsville.
9877	Brown Snake (Haldea striatula), ..	11	F. M. Arnold, Jr., Clarion.
9900	Rattlesnake, ...	11	J. W. Pressler, Nittany.
9901	(b) 3 Hellbenders (Cryptobranchus alleganiensis), ...	12	R. W. Wehrle, Indiana.
9903	Varied Tree Frog, ...	12	I. Leibersperger, Fleetwood.

SPECIMENS RECEIVED DURING JULY, 1907—Continued.

Number.	Specimens.	Date—July, 1907.	Name and Address.
9904	Red-bellied Snake,	12	W. C. Hughes, Tioga.
9915	Tree Lizard or Swift (Sceloporus undulatus),	13	H. M. Sternbergh, Reading.
9916	2 Rattlesnakes,	13	M. M. Kaufman, Clarion.
9922	Turtle Eggs,	13	J. W. Miller, Fort Hunter.
9928	Copperhead Snake,	15	Miss M. C. Brightbill, Marsh Run.
9929	Common Garter Snake,	15	L. I. Seaman, Cresson.
9930	Snapping Turtle (Chelydra serpentina),	15	J. Couch, Cannonsburg.
9931	Turtle Eggs,	15	W. P. Becker, Ebbach.
9934	(a) Musk Turtle (Aromochelys odoratus), (b) 2 Painted Turtles, (c) 3 Green Frogs (Rana clamitans), (d) 3 Meadow Frogs,	15	C. L. Gruber, Kutztown.
9946	Pilot Snake,	16	R. W. Wehrle, Indiana.
9947	Copperhead Snake,	16	E. E. C. Gibbs, Huntingdon.
9948	Blacksnake,	16	C. L. Gruber, Kutztown.
9949	Pilot Snake,	16	D. H. Uncapher, Ebensburg.
9950	House Snake,	16	C. L. Erhardt, Edenville.
9951	Common Garter Snake,	16	M. R. Good, Narvon.
9966	Sculptured Turtle,	16	C. Fegley, Harrisburg.
9981	Red-bellied Snake,	17	Mrs. S. W. Kranmer, Driftwood.
9982	Rattlesnake,	17	R. L. Jackson, McConnellsburg.
9983	Muhlenberg's Turtle (Clemmys muhlenbergi),	17	S. Omensetter, Media.
9986	Varied Tree Frog,	17	Mrs. A. F. Hughes, Tioga.
9987	Cave Salamander,	17	D. H. Bauman, Mance.
10008	(a) Box Tortoise (Terrapene carolina), (b) 4 House Snakes, (c) Grass Snake, (d) Common Garter Snake, (e) Purple Salamander,	18	N. E. Solt, Weissport.
10004	(a) House Snake, (b) Common Garter Snake,	18	G. W. Mayer, Franklin.
10015	House Snake,	18	J. S. McClay, Irvona.
10021	Common Garter Snake,	19	H. N. Partington, Harrisburg.
10023	Varied Tree Frog,	19	H. H. McGinnis, Emlenton.
10031	(a) Common Water Snake, (b) Newts (Diemictylus viridescens), (c) Box Tortoise, (d) 2 Painted Turtles, (e) 2 Green Frogs (Rana clamitans),	19	F. D. Keboch, Williamstown.
10039	Common Water Snake,	19	B. F. Swant, Crowl.
10040	Box Tortoise,	19	W. F. Dague, Mt. Alto.
10041	Blowing Viper (Heterodon platirhinos),	20	H. Fittry, Pleasant Ridge.
10042	House Snake,	20	L. B. Gilmore, Saegertown.
10043	House Snake,	20	H. Albert, Kratzerville.
10067	Common Garter Snake,	22	W. Schradley, Harrisburg.
10071	Blacksnake,	23	J. McCormick, Wilmore.
10072	Blowing Viper,	22	H. I. Grove, Sherleysburg.
10073	Copperhead Snake,	23	E. E. C. Gibbs, Huntingdon.
10074	(a) Pilot Snake, (b) House Snake,	23	E. Neal, Delmont.
10075	Common Garter Snake,	23	A. C. Rapp, Tylertown.
10076	(a) 4 Land Salamanders (Plethodon cinereus), (b) Granite Salamander,	23	C. D. Richards, Easton.
10089	Common Garter Snake,	23	Mrs. J. H. Stone, Stroudsburg.
10090	House Snake,	23	Miss L. Stewart, Oakdale.
10094	Common Garter Snake,	24	O. S. Gottshalk, Iron Bridge.
10096	Common Garter Snake,	24	W. Schradley, Harrisburg.
10114	Rock Snake (Storeria dekayi),	24	B. Matter, Harrisburg.
10120	(a) House Snake,	25	R. Templeton, Ulster.
10121	(a) Common Garter Snake,	25	Anna K. Bewley, Forest Grove.
10122	House Snake,	25	E. P. Staggerwalt, Bowmanstown.
10123	House Snake,	25	B. H. Bauman, Mance.
10124	Snake (Lampropeltis doliatus coccineus),	25	F. S. French, Bosburg.
10125	(a) Eggs of Snapping Turtle, (b) House Snake,	26	R. W. Wehrle, Indiana.
10126	Blowing Viper,	25	C. W. Hardt, Wellsville.
10127	Rock Snake,	25	A. Schradley, Harrisburg.
10143	Painted Turtle,	26	S. Baldy, Catawissa.

SPECIMENS RECEIVED DURING JULY, 1907—Continued.

Number.	Specimens.	Date—July, 1907.	Name and Address.
10145	Common Garter Snake,	26	A. A. Wood, Coudersport.
10147	Newt,	26	D. H. Bauman, Mance.
10148	Pilot Snake Eggs,	26	J. F. Beecher, Kerrsville.
10159	House Snake,	26	A. C. Rapp, Kylertown.
10161	Pilot Snake,	27	C. F. Peters, Farrandsville.
10168	Newt,	29	E. H. Bauman, Mance.
10169	Pilot Snake,	29	A. S. DeWitt, Fisher's Ferry.
10170	Common Garter Snake,	29	W. C. Hughes, Tioga.
10171	Pilot Snake,	29	A. W. Smith, Blairsville.
10172	(a) Box Tortoise, (b) Common Garter Snake,	29	W. Trageser, York.
10174	House Snake,	29	Mrs. R. S. Hampton, Union City.
10189	Blowing Viper,	30	L. G. Schaum, Womelsdorf.
10190	(a) Rattlesnake, (b) Blowing Viper,	30	E. W. Tomkins, Eatonville.
10191	Rattlesnake,	30	R. L. Jackson, McConnellsburg.
10192	Hoptoad,	30	Blyson Camping Party, Blyson-on-the-Clarion.
10193	Common Garter Snake,	30	S. Allabach, Farrandsville.
10208	Grass Snake,	30	F. G. Couch, Andersonburg.
10216	House Snake,	31	C. A. Palmer, Warfordsburg.
10226	Painted Turtle,	31	S. Wilson, Harrisburg.
	Birds and Mammals.		
9113	Vesper Sparrow,	2	A. D. Miller, Barnesville.
9744	Star-nosed Mole,	3	R. Davis. Lansford.
9746	Cedar Waxwing,	3	D. B. D. Beaver, Reading.
9769	(a) Meadow Mouse (Microtus pennsylvanicus),	5	W. Angus, Stoddartsville.
9773	Common Weasel (Putorius noveboracensis),	5	R. W. Wehrle, Indiana.
9845	Common Weasel,	9	E. C. Eterich, Aldenville.
9901	(a) Common Weasel,	12	R. W. Wehrle, Indiana.
9905	Long-eared Owl,	12	B. M. Stone, Stull.
10144	Green Heron,	26	C. W. Hart, Camp Hill.
10125	Woodcock,	25	R. W. Wehrle, Indiana.
10163	Racoon,	27	N. Fisher, Wellsboro.

SPECIMENS RECEIVED DURING AUGUST, 1907.

For each entry of which the species is determined a common specific or general name is given, followed by the scientific name. Following entries are given with the common name when that is specific, and with the scientific name when the common name is not specific name, allowing the contributor to follow the list back for the general name.

Number.	Specimens.	Date—August, 1907.	Name and Address.
	Insects.		
10238	Grape Berry Moth Larvæ (Polychrosis botrana),	1	T. T. Miller, Chestnut Hill.
10239	Bag Worms (Thyridopterx ephemeraeformis),	1	F. M. Bream, Gettysburg.
10240	Dogbane Beetle (Chrysochus auratus),	1	J. B. Small, Leechburg.
10242	Hummingbird Moth (Ampelophaga myron),	1	E. E. C. Gibbs, Huntingdon.
10244	Oyster-shell Scale (Lepidosaphes ulmi),	1	R. B. Young, Hasleton.

SPECIMENS RECEIVED DURING AUGUST, 1907—Continued.

Number.	Specimens.	Date—August, 1907.	Name and Address.
10247	(c) Beetle larvæ, ... (d) Milkweed Beetle (Tetraopes tetraophthalmus), ...	2	R. E. Scheoner, Stouchsburg.
10248	Milkweed Butterfly Pupa (Danais plexippus), ...	2	Rev. R. H. MacDade, Oaks.
10249	Abbot's Sphinx larva (Sphecodina abbottii), ...	2	Miss E. G. Ryman, Dallas.
10250	Cutworm (Noctua c-nigrum), ...	2	S. H. Dean, Mt. Carmel.
10251	Aphids, ...	2	T. Nesbit, Utica.
10253	Work of Carpenter Bee (Xylocopa virginica), ...	2	A. P. Lilley, Leroy.
10259	Variegated Cutworm (Peridroma saucia), ...	3	E. S. Mills, New Castle.
10261	Peach Borer Cocoons (Sanninoidea exitiosa), ...	3	R. M. Cummings, Montandon.
10262	Wooly Maple Aphis, ...	3	H. Strickler, Greencastle.
10263	(a) Variegated Cutworm, ... (b) Army Worm (Leucania unipuncta), ...	3	C. F. Armour, Girard.
10266	Black Witch Moth (Erebus odora),	3	R. P. Hoover, Harrisburg.
10267	Sphinx larva, ...	5	Miss A. G. Hill, Driftwood.
10270	Head of Carpenter Ant, ...	5	E. K. Kennedy, Cherry Tree.
10271	Variegated Cutworm, ...	5	G. W. Chase, Altoona.
10272	White Ants (Termes flavites), ...	5	F. Britten, Harrisburg.
10273	Work of Cucumber Root Worm, ..	5	T. K. VanDyke, Camp Hill.
10274	(a) Moth larva, ... (b) Blister Beetle (Epicauta pennsylvanica), ... (c) 12-spotted Cucumber Beetle (Diabrotica 12-punctata), ...	5	D. W. Hazleton, Ambler.
10276	(a) Blister Beetle (Macrobasis unicolor), ...	5	J. F. Dymond, Uniontown.
10279	Bagworm, ...	5	A. Safford, Reading.
10280	Pupa shell of Clear-wing Moth,..	5	D. Preston, Berwyn.
10283	San José Scale (Aspidiotus perniciosus), ...	5	J. F. Smith, Harrisburg.
10284	Ground Beetle (Calosoma scrutator), ...	5	W. S. George, Carlisle.
10290	San José Scale, ...	6	W. Minsker, Dauphin.
10292	Cecropia larvæ (Samia cecropia),..	6	G. W. Martin, Saltsburg.
10293	Tomato and Tobacco Worm (Phlegethontius 5-maculata), ...	6	R. P. Heller, Bethlehem.
10295	Imperial Moth (Eacles imperialis),	6	W. O. Heiser, Kratzerville.
10296	Arctiid Moth larva, ...	6	Mrs. J. Waugh, Washington.
10298	Shot-hole Boring Beetles, ...	6	J. F. Harshberger, Strode's Mills.
10299	Variegated Cutworm, ...	6	D. B. Wilson, Huntingdon.
10300	Oyster-shell Scale, ...	6	W. T. Hildrup, Analomink.
10301	Variegated Cutworm, ...	6	W. Day Wilson, Clarion.
10302	Variegated Cutworm, ...	6	W. P. Tate, Curwensville.
10303	Honey Bees (Apis mellifica), ...	6	L. E. Scherer, Jersey Shore.
10305	Grape Leaf Fly Galls (Cecidomyia viticola), ...	6	E. Householder, Harrisburg.
10306	Dragon Flies, ...	6	G. W. Mumma, Harrisburg.
10310	Scale Insect (Aulacaspis boisduvalii), ...	7	R. Erb, Carlisle.
10313	Lantern Fly Nymph, ...	7	J. C. Engle, Robesonia.
10314	Variegated Cutworms, ...	7	A. Hutton, New Castle.
10315	Bag Worm, ...	7	J. Gries, Essington.
10317	Polyphemus Moth (Telea polyphemus), ...	7	A. B. Miller, Barnesville.
10318	Bagworm, ...	7	F. D. Brinton, West Chester.
10319	(a) Long-horn Beetle (Orthosoma brunneum), ... (b) Variegated Cutworm, ...	7	L. B. Gilmore, Saegerstown.
10320	Orthosoma brunneum, ...	7	M. G. Hill, Rush.
10324	Roach (Ischnoptera pennsylvanica), ...	7	Mrs. A. S. Fasick, Mifflintown.
10325	(a) Regal Moth (Citheronia regalis), ... (b) Luna Moth (Actias luna), ..	8	F. M. Bream, Gettysburg.
10326	Cecropia larva, ...	8	G. J. Heim, Lancaster.
10327	Common caterpillar (Datana integerrima), ...	8	J. Couch, Cannonsburg.
10328	Tree Hopper (Enchenopa binotata).	8	E. R. Mulford, Wellsboro.
10331	Regal Moth, ...	8	J. D. Stauffer, Mechanicsburg.
10333	Work of Striped Cucumber Beetle (Diabrotica vittata), ...	8	F. D. Hall, Equinunk.

SPECIMENS RECEIVED DURING AUGUST, 1907—Continued.

Number.	Specimens.	Date—August, 1907.	Name and Address.
10334	Io Moth (Hyperchiria io),	8	Helen Morrison, Corydon.
10335	(c) Bristle-tail (Lepisma),	9	R. W. Wehrle, Indiana.
10337	Dobson Fly (Corydalis cornuta),	9	W. E. Wenner, Kimberton.
10338	(a) Tussock Moth larvæ (Hemerocampa leucostigma), (b) Arctiid Moth larvæ,	9	J. B. Clifford, McKeesport.
10340	Leaf-hopper Nymphs,	9	J. G. Pentz, Greenville.
10341	Cecropia Cocoon,	9	E. E. Hess, West Willow.
10348	(a) Granary Weevil (Calandra granaria), (b) Saw-toothed Granary Beetle (Silvanus surinamensis),	10	D. Hess, Strasburg.
10349	Variegated Cutworm,	10	L. J. Rowe, Titusville.
10350	Magnolia Scale (Lecanum sp.),	10	J. Hopkins, Juniata.
10351	Dobson Fly,	10	E. R. Buzzell, Curwensville.
10352	Milkweed Butterfly Chrysalis,	10	J. P. Runk, Newton Hamilton.
10353	Cecropia larva,	10	F. E. Chambers, Bristol.
10355	San José Scale,	10	S. B. Trostle, New Germantown.
10356	Noctuid Moth larva,	12	N. Parker, Munhall.
10357	Stem Borer (Papaipema nitela),	12	Mrs. J. E. Hayes, Liberty.
10358	Red-humped Apple Worm (Schizura concinna),	12	J. S. Wilkes, Stevensville.
10359	Abbot's Sphinx larva,	12	O. L. Fish, Wyalusing.
10360	(a) Aphids,	12	Mrs. I. P. Smith, Tyrone.
10364	(a) Lecanium Scale, (b) Wasps, (c) Hymenoptera, (d) Diperta,	12	W. H. Teas, Ridgway.
10365	Psocids,	12	G. W. Garner, Clover Creek.
10366	Psocids,	12	M. C. Kenney, Laceyville.
10367	(a) Oyster-shell Scale, (b) Tussock Moth Eggs, (c) Psocids,	12	D. M. Wertz, Quincy.
10369	(b) Leaf Beetle (Osmoderma scabra),	12	L. K. King, Westfield.
10370	Bagworm,	12	I. M. Klopp, Wernersville.
10372	Netted-veined Insects (Sialidæ),	12	L. Taylor, West Chester.
10377	(b) Sphinx larva (Pholus pandorus),	12	R. Hill, Harrisburg.
10378	Swallow-tail Butterfly larva (Papilio troilus),	12	S. F. Zook, Curryville.
10381	(b) Moth larva,	13	S. T. Styer, Danville.
10388	(a) San José Scale,	13	S. W. Garr, S. Bethlehem.
10389	Egg shells of Saturniid Moth,	13	H. B. Werner, Wernersville.
10390	(a) San José Scale,	13	F. S. Franklin, Harrisburg.
10393	Syrphid Fly pupæ,	13	W. E. Conaway, Grassflat.
10394	Bagworm,	13	R. W. Anderson, Fawn Grove.
10395	Arctiid Moth (Apantesis arge),	13	A. B. Miller, Barnesville.
10396	Walking Stick (Diapheromera femorata),	13	W. Blevenouer, Hellem.
10398	San José Scale,	13	W. Minsker, Dauphin.
10401	Mole Cricket (Gryllotalpa sp.),	14	W. Durboro, New Cumberland.
10405	Moth larvæ,	14	W. B. Reed, Chambersburg.
10407	Spotted Grape leaf Beetle (Pelidnota punctata),	14	Miss E. Robinson, West Chester.
10408	Swallow-tail Butterfly (Papilio polyxenes),	14	A. B. Miller, Barnesville.
10409	Psocids,	14	G. S. Stahl, Pennsburg.
10410	Southern Tomato Worm (Phlegethontius carolina),	14	L. M. Kerlin, Liverpool.
10411	Larvæ of Cucumber-root Worm (Diabrotica sp.),	14	J. F. Dymond, Uniontown.
10412	Bagworms,	14	M. Geary, Bryn Mawr.
10413	Macrobasis unicolor,	14	Mrs. A. Ruger, Wyalusing.
10417	Digger Wasps,	14	C. Anderson, Harrisburg.
10420	Long-horn Beetles,	15	D. S. Gerhart, Harrisburg.
10421	Psocids,	15	R. Knowlton Tladaghton.
10422	Serpentine Mines of Tineid Moth,	15	A. C. Heacock, Boyertown.
10426	Moth pupæ,	15	E. S. Mills, New Castle.
10427	Cecropia Larvæ,	15	Clara B. Steele, Tioga.
10428	Cecropia Cocoon,	15	H. J. Collins, Volant.
10429	(a) Squash Bug Eggs (Anasa tristis), (b) Insect Eggs,	15	E. W. Cooper, Oak Lane.
10430	Camel Cricket (Ceuthophilus sp.),	15	Rev. A. S. Fasick, Mifflintown.
10435	Bagworm,	16	J. H. Pecher, Fairfield.

SPECIMENS RECEIVED DURING AUGUST, 1907—Continued.

Number.	Specimens.	Date—August, 1907.	Name and Address.
10436	(b) Aphids, (c) Cottony Maple Scale (Pulvinaria innumerabilis),	16	T. F. Wells, Scranton.
10437	(a) Cicada Killer (Sphecius speciosus), (b) Noctuid Moth larva (Acronycta americana), (c) Cicada sp.,	16	G. W. Walter, Dauphin.
10438	Syrphid Fly pupa,	16	F. A. Shaw, Albion.
10439	Roach,	16	J. W. Eldred, Waynesburg.
10441	Psocids,	16	O. D. McHenry, Stillwater.
10442	Luna Moth,	16	G. C. Milleisen, Harrisburg.
10444	(a) Stag Beetle (Lucanus dama), (b) Colorado Potato Beetle (Doryphara 10-lineata), (c) Honey Bee, (e) Short-horned Grasshoppers,	16	G. Rupp and A. Hartwick, Harrisburg.
10448	Measuring Worms,	17	Gladys A. Beebe, Odin.
10449	Tussock Moth Eggs,	17	J. Hirt, Altoona.
10450	Oyster-shell Scale,	17	F. Peasley, Emporium.
10451	(a) Prominent Moth Larvæ, (b) Wheel Bug (Prionidus cristatus),	17	Miss A. Buchman, Doylestown.
10459	Moth pupa,	19	Miss L. A. Hickok, Bedford.
10460	(a) Aphids,	19	W. A. Harbison, Pittsburg.
10462	Cynip Oak Galls,	19	Mr. Livingston, Harrisburg.
10463	Regal Moth larva,	19	S. Hartley, Dunkard.
10464	Crane Flies,	19	A. B. Miller, Barnesville.
10465	(a) Red-humped Apple Worm, (b) Red-necked Prominent larva (Datana ministra),	19	J. M. Schenck, Enid.
10467	Pigeon Tremex (Tremex columba).	19	C. Moore, Wellsboro.
10479	Psocids,	20	L. S. Foulk, Schuyler.
10480	Nest of Mud Wasps,	20	W. S. Wieland, Bellefonte.
10482	Bagworm,	20	J. Haverstick, Oxford.
10483	Psocids,	20	W. H. Price, Analomink.
10484	Black Horse Fly (Tabanus atratus),	20	P. Brace, Pittston.
10485	(a) Milkweed Butterfly Chrysalid and Larva, (b) Luna Moth larva,	20	S. E. Firth, Lansing.
10486	Syrphid Fly Pupæ,	20	Dr. H. H. Bordner, Shamokin Dam.
10489	Maple Phylloxera Galls,	20	J. Shaw, Mansfield.
10490	Work of Chrysomelid Beetle on leaves,	20	W. R. Howell, Beavertown.
10493	Bagworm,	20	A. Moyer, Lucknow.
10494	(a) Regal Moth, (b) Larva of Milkweed Arctiid (Euchaetias egle),	20	E. W. Cooper, Oak Lane.
10495	Gray Maple Louse,	20	P. Vaughn, Harrisburg.
10496	Psocids,	20	N. W. Moyer, Linglestown.
10502	Hummingbird Moth (Hemaris thysbe),	21	E. A. Wilcox, Sugar Run.
10503	(b) Short-horned Grasshopper,	21	Clara B. Steele, Tioga.
10505	Milkweed Butterfly Larva,	21	H. Kerstetter, Liverpool.
10506	Regal Moth larva,	21	W. Mumma, Mechanicsburg.
10512	Luna Moth larva,	22	G. S. Stahl, Pennsburg.
10513	(a) Bagworm, (b) Tussock Moth Eggs,	22	Allentown Spinning Co., Allentown.
10516	(b) American Giant Water Bug (Belostoma americanum),	23	R. Peris, Harrisburg.
10518	Datana integerrima larvæ,	23	E. H. Dunkle, Robesonia.
10519	Parasitic Wasps (Thalessa lunator),	23	J. C. Detweiler, Fort Washington.
10520	(a) Saddle-back Larvæ (Sibine stimulea), (b) Aphids,	23	Miss J. L. Hoopes, Swarthmore.
10521	Bagworm,	23	A. H. Witmer, Lampeter.
10523	Regalis larvæ,	23	Jennie Wilson, Springtown.
10524	Grape Berry Moth Larvæ,	23	Dr. B. L. Ryder, Chambersburg.
10525	(a) San José Scale, (b) Scurfy Scale (Chionaspis furfura),	23	E. R. Cassaday, Royersford.
10526	Moth (Pantographa limata),	24	C. B. Worden, Easton.
10527	(a) Aphids, (b) Magnolia Scale (Neolecanium corniparvum),	26	W. H. Teas, Ridgeway.

SPECIMENS RECEIVED DURING AUGUST, 1907—Continued.

Number.	Specimens.	Date—August, 1907.	Name and Address.
10531	Dogday Cicada (Cicada tibicen), ..	26	F. Koneig, Harrisburg.
10532	Parasitic Wasps (Pelicinus polyturator), ...	26	C. & D. McGuire, Harrisburg.
10534	Insects, ...	26	C. Anderson, Harrisburg.
10536	Work of Morningcloak larvæ (Thanessa antiopa), ...	27	A. W. Brungard, Lock Haven.
10537	(a) Digger Wasps (Sphex ichneumonea), ... (b) Cone-headed Grasshoppers (Conocephalus sp.), ... (c) Long-horn Grasshopper (Orchelimum sp.), ... (d) Ant (Formicidæ), ...	27	A. W. Smith, Blairsville.
10538	Terrapin Scale (Eulecanium nigrofasciatum), ...	27	J. Knull, Harrisburg.
10539	Milkweed Butterfly pupæ, ...	27	S. M. Huston, Towanda.
10540	Regal Moth larva, ...	27	L. L. Cheyney, Moylan.
10541	Prominent Moth larva, ...	27	M. H. Groff, Quarryville.
10542	Honey Bees, ...	27	M. L. Main, Grand Valley.
10543	(a) Dogbane Beetle, ... (b) Lightning Beetle, ...	27	T. J. Henry, Apollo.
10544	Work of Chewing Insect, ...	27	B. L. Weaver, Steelton.
10548	(a) Twice-stabbed Lady Beetle (Chilocoris bivulnerus), ... (b) San José Scale, ...	28	Miss P. F. Waterman, Centreville.
10549	Cecropia larvæ, ...	29	Mr. Cameron, Harrisburg.
10552	Yellow Swallow-tail Butterfly larva (Papilio turnus), ...	28	Miss C. Keirn, Hastings.
10553	White Fly (Aleurodes), ...	29	H. Shenfelter, Piketown.
10555	Braconid Parasites, ...	28	C. S. Anderson, Harrisburg.
10559	Predaceous Bug (Coriscus ferus)..	29	W. Durborrow, Harrisburg.
10560	Dogday Cicada, ...	29	J. B. Zinger, Goldsboro.
10563	Rose Leaf-hoppers, ...	29	Hon. F. Wickersham, Steelton.
10564	Bagworms, ...	29	H. C. Barker, Media.
10566	Orthosoma brunneum, ...	29	A. B. Miller, Barnesville.
10567	Long-footed Grape-leaf Beetle (Fidia longipes), ...	29	R. M. Adams, Lancaster.
10568	Morning Cloak Larvæ, ...	29	L. Wagner, Philadelphia.
10569	(a) Tobacco Worm, ... (b) Microgaster Cocoons, ...	29	T. H. Parker, Norristown.
10570	Moth Larvæ (Halisidota caryae), ..	29	Miss. G. A. Beebe, Odin.
10572	Dragon Flies, ...	29	Miss T. McEldery, Transfer.
10573	Oyster-shell Scale, ...	29	F. Peasley, Emporium.
10579	(b) Stink Bug, ...	29	P. K. Hartman, Adamstown.
10582	Collection of Beetles, ...	30	Dr. Raub, Lancaster.
10584	Lecanium Scale, ...	30	Henry Bush, North Point.
10585	(a) Tree Bugs (Brochymena sp.), (b) Stink Bug, ...	30	G. R. R. Warburton, Granville Summit.
10588	(a) Pigeon Tremex, ... (b) Diptera Fly Larvæ, ...	30	Miss C. Salmon, Lock Haven.
10590	San José Scale, ...	30	W. H. Moist, Ryde.
10593	Io Moth larva, ...	31	E. K. Roden, Scranton.
10594	Work of June Beetle, ...	31	P. Z. Supplee, Collingdale.
10595	Bagworms, ...	31	J. Milligan, Wellsville.
10596	(a) Calosoma scrutator, ... (b) Tobacco Worm, ...	31	T. Y. Cooper, Hanover.
10597	Slug Caterpillars, ...	31	Mrs. W. E. Mehaffie, Duncannon.
10600	Spotted Grape Vine Beetle, ...	31	J. Ripley, Harrisburg.
	Invertebrates Not Insects.		
10388	(b) Mites, ...	13	S. W. Garr, South Bethlehem.
10436	(a) Mites, ...	16	T. F. Wells, Scranton.
10444	(d) Spider, ...	16	G. Rupp and A. Hartwick, Harrisburg.
10452	Annulata, ...	17	S. H. Derickson, Annville.
10488	Mites, ...	20	P. Rothwell, Troy.
10503	(a) Millipede, ...	21	Clara B. Steele, Tioga.
10545	Red Mites, ...	27	B. L. Heagy, Palmyra.
10551	Mites, ...	28	Dr. W. C. Baker, Hummelstown.
10561	Mites, ...	29	A. E. Strode, Paxtang.
10579	(a) Millipedes, ...	29	O. K. Hartman, Adamstown.
10587	Spider, ...	30	J. Ripley, Harrisburg.
10601	Crab Spider, ...	31	E. S. Sheaffer, Harrisburg.
	Reptiles and Batrachians.		
10228	Copperhead Snake (Agkistrodon contortrix), ...	1	D. V. Ferguson, Lumber City.
10229	Common Lizard (Sceloporus undulatus), ...	1	H. A. Brightbill, Jr., Marsh Run.

SPECIMENS RECEIVED DURING AUGUST, 1907—Continued.

Number.	Specimens.	Date—August, 1907.	Name and Address.
10230	Spotted Salamander (Amblystoma punctatum),	1	Blyson Camping Party, Blyson-on-the Clarion.
10231	Common Garter Snake (Thamnophis sirtalis),	1	S. Helsel, Queen.
10232	Common Water Snake (Natrix sipedon),	1	D. H. Bauman, Mance.
10233	Common Water Snake,	1	E. Green, Farrandsville.
10243	Blacksnake (Bascanion constrictor),	1	W. E. Benner, Vicksburg.
10245	House Snake (Lampropeltis doliatus triangulus),	2	J. H. Drill, Cogan House.
10246	(a) Common Garter Snake, (b) Green Frog (Rana clamitans),	2	G. W. Seaman, Wilmore.
10247	(a) Two-lined Salamander (Spelerpes bilineatus), (b) Brown Salamander (Desmognathus fusca),	2	R. E. Schoener, Stouchsburg.
10254	(a) 2 Common Water Snakes, (b) Bull Frog (Rana catesbeana), (c) 2 Green Frogs,	2	G. T. Frey, Emigsville.
10256	Pilot Snake (Callopeltis obsoletus),	3	F. E. Taylor, Mercersburg.
10257	Common Garter Snake,	3	D. H. Bauman, Mance.
10268	Rattlesnake (Crotalus horridus),	5	J. P. Kane, Farrandsville.
10277	Turtle Eggs,	5	W. S. Bienenouer, Hellam.
10286	Pilot Snake,	6	O. N. Shaffer, Hyndman.
10287	Copperhead Snake,	6	W. M. Flanagan, Columbia.
10288	Common Garter Snake,	7	Blyson Camping Party, Blyson-on-the Clarion.
10289	Snapping Turtle (Chelydra serpentina),	6	J. D. Shephard, Wellsboro.
10307	Common Garter Snake,	7	W. Swift, Farrandsville.
10308	Common Garter Snake,	7	W. H. Gretchman, Meyersdale.
10309	3 Striped Water Snakes (Regina leberis),	7	G. W. Gordon, Brownsville.
10321	Sculptured Turtle (Clemmys insculptus),	7	S. Anderson, Harrisburg.
10322	2 House Snakes,	8	E. Neal, Delmont.
10323	House Snake,	8	W. A. Shupe, Scottdale.
10332	Pilot Snake,	8	F. E. Taylor, Mercersburg.
10335	(a) Box Tortoise (Terrapene carolina),	9	R. W. Wehrle, Indiana.
10344	Common Garter Snake,	10	C. Kuepp, Farrandsville.
10345	House Snake,	10	J. D. Earon, Farrandsville.
10346	Granite Salamander (Plethodon glutinosus),	10	R. W. Wehrle, Indiana.
10369	(a) House Snake,	12	L. K. King, Westfield.
10373	Box Tortoise,	12	G. H. Nesley, Pottstown.
10375	Box Tortoise,	12	Miss K. Edwards, Harrisburg.
10377	(a) Box Tortoise,	12	R. Hill, Harrisburg.
10380	Copperhead Snake,	13	Smith & Yuckenberg, Indiana.
10381	(a) Common Water Snake,	13	S. T. Styer, Danville.
10382	Rattlesnake,	13	W. Palen, Eatonville.
10384	Common Garter Snake,	14	A. C. Rapp, Kylertown.
10385	Newt (Diemictylus viridescens),	13	G. J. Winmer, Nazareth.
10386	Common Water Snake,	13	Mrs. R. S. Hampton, Lincolnville.
10398	Common Garter Snake,	14	J. E. Peters, Markleton.
10400	Common Water Snake,	14	H. Williams, Connellsville.
10408	House Snake,	14	B. H. Bauman, Mance.
10416	Pilot Snake,	14	J. G. Oberdorf, Mifflinburg.
10419	Common Water Snake,	14	Mrs. R. S. Hampton, Lincolnville.
10434	Copperhead Snake,	16	D. V. Ferguson, Lumber City.
10445	Copperhead Snake,	17	F. J. Nester, New Ringgold.
10446	(a) Common Water Snake, (b) 6 Brown Salamanders,	17	R. W. Wehrle, Indiana.
10447	Common Garter Snake,	17	Dr. H. B. Meredith, Danville.
10454	Leather-back Turtle (Aspidonectes spinifer),	19	J. Custer, Stoyesville.
10455	Common Garter Snake,	19	A. F. Smith, Blairsville.
10456	Rattle Snake,	19	Alonza A. Phillips, Farrandsville.
10457	House Snake,	19	A. O. Apker, Penfield.
10458	Hellbender (Cryptobranchus alleganiensis),	19	R. W. Wehrle, Indiana.
10473	Common Garter Snake,	20	G. H. Rea, Reynoldsville.
10474	House Snake,	20	C. Breed, Tioga.
10475	2 Common Water Snakes.	20	A. W. Smith, Blairsville.
10476	Common Water Snake,	20	Miss J. Relehan, Lock Haven.

SPECIMENS RECEIVED DURING AUGUST, 1907—Concluded.

Number.	Specimens.	Date—August, 1907.	Name and Address.
10477	(a) Blacksnake, ...	20	A. H. Stevens, Enid.
	(b) 5 Rattlesnakes, ...		
10478	2 Copperhead Snakes, ...	20	H. E. Smith and H. G. Yuckenberg, Indiana.
10497	2 Cave Salamanders (Spelerpes longicauda), ...	20	Dr. J. M. Keath, Schaefferstown.
10498	Red-bellied Snake (Storeria occipitomaculata), ...	21	A. C. Rapp, Kylertown.
10499	Grass Snake (Liopeltis vernalis), ..	21	C. B. Steele, Tioga.
10501	Blacksnake, ...	21	E. G. Vought, Elysburg.
10507	(a) Box Tortoise, ...	22	R. W. Wehrle, Indiana.
	(b) 2 Green Frogs, ...		
10508	Grass Snake, ...	23	D. H. Bauman, Mance.
10510	Common Garter Snake, ...	22	R. Kuepp, Farrandsville.
10511	Cave Salamander, ...	22	W. Don Morton, McConnellsburg.
10514	Pilot Snake, ...	23	R. W. Wehrle, Indiana.
10515	Rattlesnake, ...	23	A. P. Quick, Milford.
10516	(a) Common Water Snake, ...	23	R. Perls, Harrisburg.
10529	Common Water Snake, ...	26	R. D. Ulmer, Cogan House.
10530	(a) Blue-tailed Skink (Eumeces fasciatus), ...	26	J. A. Shuey, Penbrook.
	(b) Common Lizard, ...		
10535	Pilot Snake, ...	26	F. G. Couch, Andersonburg.
10546	(a) Common Water Snake, ...	28	G. A. Palmer, Warfordsburg.
	(b) Blowing Viper (Heterodon platirhinos), ...		
	(c) Painted Turtle (Chrysemys picta), ...		
10547	(a) Common Water Snake, ...	28	J. Couch, Canonsburg.
	(b) 2 Common Garter Snakes, ..		
	(c) 4 Leopard Frogs (Rana pipiens), ...		
	(d) Red Salamander (Spelerpes ruber, ...		
10554	Eggs of Blacksnake, ...	28	J. F. Reisinger, Ickesburg.
10556	Blowing Viper, ...	29	D. H. Bauman, Mance.
10557	Sculptured Turtle, ...	29	G. Baker, Noxen.
10558	Common Garter Snake, ...	29	D. H. Uncapher, Ebensburg.
10578	Blacksnake, ...	29	T. Oxford, Jr., Bangor.
10583	Red-bellied Snake, ...	30	Miss F. M. Benedict, Girard.
10589	Common Water Snake, ...	30	F. M. Brubaker, Johnstown.
10598	Eggs of Box Tortoise, ...	31	M. P. Hartzell, Lebanon.
10604	House Snake, ...	31	W. Parks, Linglestown.
	Birds and Mammals.		
10330	White-footed Mouse (Peromyscus leucopus), ...	8	J. W. Jacobs, Waynesburg.
10335	(b) Brown Bat (Vespertilio fuscus), ...	9	R. W. Wehrle, Indiana.
10336	Catbird (Galeoscoptes carolinensis).	9	Mrs. J. Waugh, Washington.
10374	Brown Bat, ...	12	Miss P. Wise, Harrisburg.
10387	Brown Bat, ...	13	Miss H. Gise, Harrisburg.
10425	Night Hawk (Chordeiles virginianus), ...	15	E. F. Elsely, Harrisburg.
10433	Great-horned Owl (Bubo virginianus), ...	16	N. M. Naginey, Milroy.
10507	(c) Marsh Hawk (Circus hudsonius), ...	22	R. W. Wehrle, Indiana.
10509	Meadow Mouse (Microtus pennsylvanicus), ...	22	W. Angus, Stoddartsville.
10528	Sharp-shinned Hawk (Accipiter velox), ...	26	J. Schraedley, Middletown.
10577	(a) Sharp-shinned Hawk, ...	29	W. G. Judson, Meshoppen.
	(b) Marsh Hawk, ...		
10592	Sparrow Hawk (Falco sparverius),	31	W. G. Judson, Meshoppen.

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EXPLANATION OF PLATES.

Plate XXX. Red Triton (*Spelerpes ruber*, Daud.) Adult, nearly natural size. Photographed from life, under water, by Dr. R. W. Shufeldt.

Plate XXXI. Blue-tailed Lizard (*Eumeces fasciatus* Linn) Dorsal and ventral views. Kindly loaned by Prof. S. R. Morse, Curator of New Jersey State Museum, published in his "Annual Report for 1906."

Plate XXXII. Ground Lizard (*Leiolopisma laterale* Say.) Dorsal, ventral and side views. Kindly loaned by Prof. Morse, Curator of the N. J. State Museum, published in his "Annual Report for 1906."

Plate XXXIII. Common Lizard (*Sceloporus undulatus* Daud.) Dorsal and ventral views. Kindly loaned by Prof. Morse, Curator of the N. J. State Museum, published in his "Annual Report for 1906"

Fig. 26. Blue-tailed Lizard (*Eumeces fasciatus* Linn.) Dorsal, ventral and lateral views of head; and arrangement of scales on side of body and on hind leg and base of tail, ventral view. Kindly loaned by Prof. S. R. Morse, Curator of N. J. State Museum, from his Ann. Rep. 1906.

Fig. 27. Ground Lizard (*Leiolopisma laterale* Say.) Kindly loaned by Prof. Morse, Curator of the N. J. State Museum, from his Ann. Rep. 1906.

Fig. 28. Common Lizard (*Sceloporus undulatus* Daud.) Kindly loaned by Prof. S. R. Morse, Curator of the N. J. State Museum, from his Ann. Rep. 1906.

PREFACE.

The title of this publication as "The First Report on Pennsylvanian Lizards" indicates the possibility of a second or subsequent report. Studies are continuously being made in the office of the Economic Zoologist to obtain additional important facts concerning the fauna of our State. There is scarcely a creature found, native or undomesticated, within the borders of this State of which as much is known concerning it as should be known in order to say with certainty that it is beneficial or obnoxious and to show how to suppress it if it be objectionable, or to preserve it and increase its race if it be beneficial.

We need notes or reports of observations concerning the appearance of such creatures, their habits, haunts, food, methods and dates of reproduction, care of eggs and young, enemies, abundance, and other points that are worthy of entering into the second and more complete publication upon this subject. We, therefore, invite all observers to send us definite records of their observations, in order that we may be able to add them to those made by others and ourselves, and thus prepare a more useful publication than would be possible were it not for the benefits of co-operation in making observations and records.

We also need many more specimens collected at different places and at different times of the year, and would, therefore, urge readers to make a special effort to collect such specimens and send them to us, by mail or express, at our expense. Specimens should be killed at once, by shooting with very fine shot, or by sticks, snares or other means, and sent immediately, by mail or express, to the Economic Zoologist. They will be acknowledged and identified, questions will be answered concerning them, and in later publications credit will be given to persons contributing them. The next publication upon this subject by this office will be sent free first to those persons contributing notes of observations or specimens, and in order to be sure to receive the second report, it is well for persons who are especially desirous of obtaining it, to make a particular effort during the summer to collect and send us specimens or recorded observations, such as are desired.

All communications and specimens should be addressed to

H. A. SURFACE, ECONOMIC ZOOLOGIST,

Harrisburg, Pa.

FIRST REPORT ON THE LIZARDS OF PENNSYLVANIA.

LACERTILIA. THE LIZARDS.

The Lizards are Reptiles that are not covered with shields nor plates, but the body is usually protected by overlapping scales; the bones of the upper and lower jaws are more closely united than in the serpents, and the mouth is consequently not dilatable. The quadrate bone, which moves freely in the serpents and permits the mouth to open to a tremendous extent in those reptiles, is present in the Lizard but is joined to the skull and does not perform the same functions as in the serpents. The jaws of Lizards are always provided with teeth, but never with fangs. The limbs are four in number, distinct, sometime rudimentary and hidden by the skin. The tail is usually long and is most cases is very brittle and separates readily from the body by a slight blow. This serves an important purpose in permitting its owners to escape. It has often happened that a bird, serpent, or some other enemy has attempted to catch a Lizard and has been greatly surprised to find the tail remain wriggling violently while the body of the animal quietly and very speedily slips away with safety. The tail is then renewed or again grows, but if there is an injury to the bone at the place of separation it often results in two or more tails developing and sometimes having the appearance of toes on a foot, thus resembling a fifth foot. It not unfrequently happens that persons attempting to pick up Lizards by the tail find in their hand only the wriggling appendage, after the body has disappeared to a place of safety.

The Lizards are mostly tropical and subtropical in their distribution, and only five species are known with certainty to occur within the borders of the State of Pennsylvania. Some of these are so rare in this State that we have found no opportunity to study their habits, and specimens are desired. None are common in this State, as this is very near their northern limit of range, where they naturally are more rare.

Lizards live mostly in very hot and dry places and in such places as Salamanders would not frequent. They avoid to a great extent water and swamps, although they will plunge into water and swim to escape a pursuer.

A common error is made in referring to the Salamanders as Lizards. The Salamander is not a Lizard, and in fact does not be-

long to the class of reptiles but to the amphibians. They are more closely related to the frogs than to the Lizards. [See Plate 1.] Salamanders always lay eggs in water or very damp places, and the young are tadpoles, breathing at first by means of gills, and later transforming into animals of the same form and species as their parents. No Salamanders are in any way dangerous or poisonous, and the common fear and superstition concerning these animals is entirely unfounded. Their skin is always smooth, without scales, and cool, moist and slimy. They should not be mistaken for a Lizard. These Amphibians will be discussed in a separate Report which we are now preparing to issue as a Monthly Bulletin of the Division of Zoology some time in 1908.

The Lizards lay eggs, or bear living young, away from the water and spend no portion of their life whatever in the water, and do not undergo metamorphosis as do the Salamanders. All of the species of Lizards found in Pennsylvania reproduce by laying eggs and all are readily recognized by the presence of small scales covering both the upper and under sides of the body, the four legs present, and the long tail.

It is too commonly and wrongly believed that a Lizard is venomous or poisonous and can inflict injury. These creatures are entirely harmless to mankind, and have no power to do him injury, although they are decidedly beneficial in their economic relations in feeding almost entirely upon insects. A detailed discussion of their food will be found under each respective species which we have studied in detail. More specimens are desired to aid in these investigations.

LIZARDS REPORTED IN THE HUMAN STOMACH.

Another common error concerning the Lizard is that it can live in the human stomach and is sometimes swallowed with water and causes serious stomach trouble. Quack doctors make use of this belief to impose upon their patients, and enrich themselves. No reputable physician and no zoologist will accept as true the statement that any Lizard or Salamander, Serpent or other Reptile or Amphibian can live in the human stomach for ten minutes. There has been considerable discussion of this subject, but it is well established that many patients who have been suffering from stomach trouble, such as severe indigestion, cancer of the stomach or some other malady, have found this organ so intimately connected with the brain as to cause mental delusions, resulting in the belief in the internal Lizard or Salamander.

There has been a great deal published in the newspapers concerning Lizards living in the human stomach. We have had considerable

correspondence upon this subject. One of our most interested correspondents is Dr. D. J. Doran, of Gloucester City, N. J. A letter from him and our reply are as follows:

Prof. H. A. Surface, Harrisburg, Pa.:

Dear Sir: I see by published accounts your opinion that Lizards were never swallowed by people, and as I have given that particular subject much study, I take the liberty of writing to you.

All writers that I have seen, on parasites, agree with you, and I also have a letter from the late Professor E. D. Cope, the famous Naturalist of the Smithsonian Institute at Washington, D. C., and from physicians of all schools saying the same as you, in substance, that Lizards, even if taken into the stomach as "eggs" on food, or from the surface of a shady spring, would soon be used up by the heat of the stomach, being reptiles, and in the process of digestion all traces of Mr. Lizard ends. Scientists who have read up on Parasites and pose as authorities continue to deny this, as in your case, but nearly everyday newspapers publish a lizard story, and no good denial is ever made. Only the stereotyped denial handed down from ages. So it might be asked, "Why don't it settle these lizard stories, like the medical myths that are being wiped out every day, one by one?"

There still remain persons who are slow to accept your views as final, when we find a Doctor K., a worm doctor, with colored pictures displayed in his window, showing Mrs. So and So, the lizard alleged to be removed, the spring, etc. He issues descriptive literature, testimonials about cases of lizards being swallowed and removed by his stuff, and has numerous specimens in stock as well as cartloads of tapeworms. I cite him to show how the public continues to believe that lizards do happen to be an accidental parasite of the digestive apparatus. I took up this subject some years ago when a man showed me a lizard, such as is seen on fences, and I identified it, showing it was not a newt. He claims it was in his stomach three years and came up by vomiting, and he still insists it is true. His lizard could not have come from a "spring" as here only Newts are found so if in his stomach the "egg" may have been eaten on vegetables that were attacked by some fence lizard, as does happen in the case of other parasites. As I don't know the father of the tapeworm, I am still in doubt about the lizard, and have no opinion to state whether lizards could live in a man's stomach or not; so if you continue this subject by writing a magazine article relating thereto, or any matter published, I would be pleased to know it, as literature on this subject is very interesting to me.

I remain yours respectfully,

D. J. DORAN.

Reply:

"My Dear Sir: I thank you for your letter calling my attention to the widely spread belief that, nothwithstanding what most physicians and all zoologists may have to say, it may nevertheless be true that such creatures as lizards do live in the human stomach. I note with particular interest that you say you have a letter from the late Prof. E. D. Cope, stating that lizards, after taken into the stomach, would soon be killed and digested, and all traces of the lizard would end. This is correct, but I should certainly thank you most cordially if you would be willing to loan me that letter, in order that I could copy it at once and return it to you. I should be willing to use it in my forthcoming Bulletin on this subject and give you full credit for the same.

I would call your attention to the fact that such creatures as lizards and salamanders are not parasites, and are not adapted to internal parasitic life that other worms endure. They must breathe free air or be suffocated, as could be observed by putting one in a bottle and corking it tightly.

The person who poses as a "worm doctor," with colored pictures and specimens whose origin may by no means be authentic, is of course, a quack, and the very fact that he makes a display such as you mention shows that he is a quack and impostor and cares nothing about disseminating the truth, but advances only his own interests in obtaining money. There is no doubt about the existence of the tapeworm as an internal parasite, and the comparative ease with which it can be remedied. Consequently, it may be possible for such a person to obtain specimens of these true parasites and catch lizards from the woods and add them to his collection in order to make it more impressive. As long as the public is so uneducated as to accept what such quacks have to offer rather than to accept the statements of such professional naturalists as Prof. E. D. Cope and Dr. G. Brown Goode, they may abide by the results of their own ignorance, as I and other students of such subjects care more for the opinion of Prof. Cope and Dr. Goode when definitely expressed than for that of all quacks on the earth.

When the man showed you the fence lizard, which he claimed was in his stomach three years and was ejected, you should have learned the detailed facts of the case. It may have been a case of hysteria, mild insanity, opium or other "delusion." The mere exhibition of a specimen and the statement of that kind does not make it true. This I have proven conclusively in recent correspondence on this subject which I could submit to you if I had time.

The fact is, as you say, that this species of lizard does not live in the water, as does the newt, and consequently could not have

been swallowed by drinking water; and also could not have been eaten as an egg on a vegetable. Positively, I do not believe that any human stomach ever contained a live lizard, and if any other such creature should find its way into the human stomach it could not exist there more than a few minutes at the most.

The tapeworm does not transform into some other higher creature but produces eggs from which develop small worms encysted in delicate membrane, which may not be larger than a pea, and to complete their development must be swallowed with uncooked or "rare" meat which they infest. There is no transformation into a large creature like a winged insect or lizard, or anything of that kind.

I do not think it proper to apply the word "parasite" to a lizard or salamander, under any circumstances, as they are entirely different from the true internal parasites, and if they could be imagined as living in the human stomach, they would be no more parasites than are squirrels which live inside of trees.

I note the enclosed slip in which you state that Jeffrey's in his work on "Parasites" says, "The only reason why amphibians, frogs and lizards can not permanently live in the human body is the moisture and heat which is at least 80 degrees Fahr., which no specimen of amphibian can resist from two to four hours." I beg to say that this is entirely untrue. The real reason why such creatures could not live in the human body are (1) the absence of atmosphere or any means of respiration, which suffocates them at once, and (2) the extreme severity of the gastric juices, would kill them and they would be digested. Such a creature would have no more prolonged existence in the human stomach than would a piece of beefstake. Also Mr. Jeffrey's is wrong in stating that the temperature of the human body is "at least 80 degrees Fahr." We know that it is almost constantly 18 degrees more than that, and we also know that it is not infrequent to see frogs and salamanders in the open, where the temperature of the atmosphere surrounding them is more than 80 degrees or even 98 degrees Fahr., and lizards themselves often lie on hot exposed stones at a temperature of over 100 degrees. Moisture and such mild temperature as 80 degrees would be congenial to the living frogs, salamanders and lizards, and I am surprised that any person presuming to be an author should make such a statement as the above, which you have kindly copied and sent to me.

What I shall publish upon this subject will be in my Monthly Bulletin, which is now in the course of preparation, and I shall be pleased to have you receive a copy of the same.

Very truly yours,

(Signed)

H. A. SURFACE, ECONOMIC ZOOLOGIST.

Mr. Doran was in correspondence with two of the greatest authorities in America upon this subject in 1896, and kindly sent us the letters from Prof. E. D. Cope and Dr. G. Brown Goode, which give greater emphasis to the statement here made. These are worthy of publication and preservation and are as follows:

Smithsonian Institution,
Office of Assistant Secretary,
In charge of U. S. National Museum.

S. P. Langley, Secretary,
G. Brown Goode, Assistant Secretary.

Washington,

Mr. D. J. Doran, Gloucester City, New Jersey.

'Dear Sir: In reply to your letter of June 8, I can only say that it is more than improbable, if not altogether impossible, that the lizard lived in the man's stomach, as he claims, nor is it at all probable that he vomited it up. Stories of this kind are frequently told, and the institution is constantly receiving them. In the present instance it may not be an intentional mis-statement on the part of the young man to whom you refer. It may simply be a case of self-delusion.

Yours respectfully,
(Signed)
G. BROWN GOODE,
Assistant Secretary, Smithsonian Institution, in charge U. S. National Museum.

2102 Pine St., Phila., Pa.

Dr. D. J. Doran,

Dear Sir: The man who told you that he had a live lizard in his stomach for three years probably lied. All the newspaper stories of a similar nature are also inventions of those in charge of the paper, or copies of some other journals that have also lied. The physicians are right on this point, that it is impossible for lizards, etc., to live in a human stomach. If a reptilian egg should by chance be hatched in a man's stomach, the animal would soon die. As to your last question, lizards are not parasites, so that you will not find any reference to them in any work on parasites.

Very truly yours,
(Signed) E. D. COPE.

We have persistently made effort during recent years to follow up by correspondence any reports in the newspapers purporting to give accounts of lizards or similar creatures in the human stomach. In

no case could we find satisfactory evidence of the truth of such report. As the result of our correspondence a few interesting instances have come to light. For example, in 1905 there was published extensively a report of a lizard having been voided by a patient, near Marietta, Pa. The name of the Doctor was given, as well as the name of the patient, and as the evidence was circumstantial and apparently reliable we wrote to the physician and received a reply that there was a basis for such report, but that in his opinion the material consisted of fragments of a tapeworm instead of a lizard. This of course is quite possible.

In 1907 there appeared several published reports concerning an actress dying in a Hospital in Omaha, Nebraska, and lizards crawling from her mouth at the time of her death. We wrote to the Mayor of Omaha, concerning this and he replied that while such a person had recently died there, the story concerning the presence of lizards, or anything of that kind, was entirely false.

We also received a report of two "lizards" having been vomited by a woman in Berks county and that the specimens were preserved in spirits and we could examine them ourselves. We sent for the specimens and were fortunate enough to procure the two specimens in a bottle of alcohol. Upon examination they were found to be Cave Salamanders, (*Spelerpes longicauda*), such as live commonly beneath the bark of fallen logs in this State. In their stomachs were found Wood Flies, which showed that within a few hours previous to their death they had been living in their native haunts in the woods, and had been feeding upon flies flying around the logs. Thus they could not have been in the stomach of the woman for two years, as was stated. The physician, who knew the woman quite well, was at first inclined to believe her story, but wrote us later that he believed it to be a case of hysteria or extreme nervousness, with a possibility of mental derangement, and the women may have contrived to collect the salamanders from the woods and during a fit of extreme nausea may have produced them to convince other persons in accepting her belief as to the cause of her troubles. While one of her relatives yet maintains the theory that the creatures had been in her stomach, the evidence was such that it can not be accepted.

THE FOOD OF PENNSYLVANIA LIZARDS.

As far as we can learn, this is the first time that a detailed study has been made of the food of Lizards and Turtles, *and consequently there must be much interest attached to the definite statements here made. Some general remarks have occasionally been published concerning the food of these creatures, but it is evident that definite careful dissections and a specific study of the subject have been almost neglected until the present time. As all specimens and contents of stomachs are preserved permanently in the office of the Economic Zoologist, it will not be a difficult matter for any person to verify these studies or look over them further at any time in the future. The records and specimens of this office are open to the free use of investigators who may wish to use this material for further studies in seeking the truth.

It is to be noted that this publication is offered as the First Report of the Lizards of Pennsylvania. This indicates the contemplation of the publication of subsequent reports, from time to time, as sufficient material accumulates in our hands to justify the publication of additional important facts. This implies the fact that we desire more specimens of Pennsylvanian Lizards and Turtles in order to advance these studies to points of certainty. In sending this publication to our contributors in various parts of the State we are only returning to them our part in the interest of their own labors and assistance. We invite further help along these lines for the sake of aiding in ascertaining the truth concerning the creatures too often dispised and neglected, but which evidently have an important sphere in the grand Scheme of Nature.

Attention should be called to the fact that the creatures commonly called "Lizards" are really Salamanders and not Lizards. Salamanders are Amphibians or Batrachians and belong to the same general Class or same Branch of animals as the frogs. They live in the water or in damp places, and have moist or slimy skin, lay eggs in water or damp terrestrial places from which hatch young that have gills, resemble tadpoles, and undergo metamorphosis similar to that of frogs and toads. Lizards are indeed Reptiles and not Amphibians or Batrachians. They have all the attributes of reptiles; they are covered with scales, live in warm dry places,—never in water, and some lay eggs from which hatch young that are not tadpoles, but are similar to their parents, while others bear living young.

Although only two species of Lizards were sufficiently common in this State to enable us to make a study of their stomach contents, we have collected enough specimens of the Swift to give us

*Our Report on Pa. Turtles is to be issued soon as one of our monthly Bulletins.—H. A. S.

fairly safe conclusions as to food and to show it is of decidedly economic value in aiding to suppress snails and insects of objectionable kinds.

Of the specimens of Swifts examined only twenty-five contained food, but this number is far more than has before been definitely examined and recorded. Therefore, even in this limited study certain new points are to be brought forth. Of these Pennsylvanian Lizards twenty-five were the species known as the "Swift" and one was the "Blue-tailed Lizard." The differences of species are given in descriptions elsewhere in this Bulletin.

It is to be noted that not one Lizard was found with any vegetation or vegetable material in its stomach, and we are thus justified in the conclusion that Lizards cannot injure vegetation and are therefore safe in orchards and woods, as far as concerns any probability of their injury to trees or other plants. Three Lizards had eaten snails, and in so doing were rendering an important service to mankind in aiding to destroy the pests of the garden. One had swallowed a species of crustacean, such as is often found under boards in damp places, and known as the sow bug or pill bug, and five had eaten spiders. All the Lizards examined had partaken of insect food, showing that they are almost wholly insectivorous in their feeding habits. In this connection it is important to note that they did not feed on insects belonging to the lower entomological orders. These insects are generally the aquatic species, or those living in or near the water. In this fact may be found the explanation as to why they were not taken as food of these reptiles which live almost wholly in very dry situations. Only one aquatic insect was found eaten by a Lizard, and as this was an adult or winged Stone Fly it may have flown to a dry region inhabited by a Lizard rather than the latter coming to the low or damp grounds to find food.

It is interesting and important to note that six specimens of Lizards, or about one-fourth of the total number examined, were found to have eaten grasshoppers. These were nearly all the so-called Short-horned species (Acrididae), and are the kinds that are quite destructive to vegetation. It is important to note that the Long-horned Grasshoppers, of the family Locustidae, were not eaten by Lizards. An explanation of what may appear to be a choice in favor of the Short-horned species as against the Long-horned species is to be found in the fact that in this State the grasshoppers belonging to the latter family live mostly in damp regions, such as are avoided by the Lizards, while the Acrididae or Short-horned grasshoppers are found in fair abundance even on the dry and rocky mountain sides which the Lizard frequents. Thus

the place of living or haunt would determine not only the food which the creature obtained, but also the natural enemies which it would meet.

Two Lizards had eaten crickets, but the fact that so few crickets were taken, while so many Short-horned grasshoppers were devoured, would indicate the Lizard as a daytime feeder, while it is known that crickets would be available for their enemies by night rather than by day, when they are more active and come forth from their retreats. It is remarkable to note that of the very large order of Hemiptera or Bugs only three specimens had been eaten by Lizards. Two Lizards contained insects which upon careful examination proved unquestionably to be a kind that are commonly called Stink Bugs, belonging to the family Pentatomidae. This indicates that the Lizards do not take their food by smell, and may make but very little use of the senses of smell and of taste. In destroying these objectionable creatures the Lizards are rendering an important service to mankind, especiallly in the preservation of certain plants.

Note that the aquatic Bugs were entirely ignored as food by Lizards, and this again indicates the important relationship of habitat (haunt) or place of living in regard to the kind of food that is available and is taken. In this regard strict comparison and contrast should be made with the study of the food of the Painted Turtle, to be discussed in a later Bulletin.

While we must chronicle the fact that only one Lizard had eaten an adult or winged moth, seven had feasted upon moth larvae or caterpillars, commonly called "worms." In the destruction of these pests Lizards proved their beneficial quality, especially as shown in the fact that two of the larvae were identified as cutworms. It is known that the Lizard is a creature which becomes quiet or dormant when the weather is cold, and also after night when the air is more chilly, and becomes more active in the day time, especially when the sun is hot. It is evident that these habits have an important relationship to its food, and the moths, being almost wholly nocturnal creatures, would not be expected to contribute extensively to the menu of such a creature as the Lizard. The night-flying insects were not found extensively eaten by these animals. The fact that twenty-one per cent. of all the stomachs of lizards contained caterpillars is enough to justify the suggestion of placing these harmless little animals in orchards to aid in preserving the trees.

While the climate of Pennsylvania is not adapted to the great multiplication of Lizards and it is the opinion of the writer that the artificial propagation of Lizards as natural enemies of insects would not be practical in this State, yet steps toward this might be taken

with satisfactory results further South. We have heard of a fruit grower in Georgia who paid the colored boys one cent each for living Lizards, and upon turning these creatures into his orchard, placing one on each tree, he found that they not only aided in suppressing the insects and other pests of the trees and fruits, but gave particularly valuable service in preventing tresspassing upon his property on the part of ignorant and superstitious persons who regarded the Lizards as capable of inflicting great bodily injury, and who would not therefore think of entering his orchard under any circumstances.

It is rather surprising to note that only one specimen of Lizard was found to contain flies, or insects belonging to the order Diptera. This may in part be due to the readiness or quickness by which these particular insects are digested, and in part to vigilance and speed of the flies in watching for and escaping their enemies.

Beetles form the chief bulk of the diet of Lizards as fifteen, or about sixty per cent. of all, were found to have eaten insects belonging to this entomological order. It is noteworthy that we found no ground beetles in the stomachs of Lizards, and owing to the absence of these, and other beneficial insects in general, we must declare that Lizards are not justly liable to the charge of exerting an objectionable influence on the property of mankind by the destruction of his insect friends. It is indeed remarkable how few insect friends or beneficial insects were found eaten by members of this group of reptilian life, which are almost wholly insectivorous in the feeding habits.

Three Lizards ate click beetles, which are the adult or mature forms of wireworms, which are so destructive to cultivated plants of various kinds. As there is no satisfactory remedy for wireworms, we have very important justification in learning and preserving their natural enemies.

Three Lizards were found to have eaten Ichneumon flies, which are parasites in insects of various kinds, and thus are generally to be called beneficial, but when in turn they are parasites upon beneficial insects they become obnoxious from an economic standpoint, and their enemies would be beneficial in results. However, it must be recognized that in the destruction of the Ichneumon flies, and perhaps also of spiders, the Lizards are overstepping the strict bounds of economically beneficial creatures, as set forth from the rather selfish standpoint of mankind.

It is, of course, to be expected that vertebrates would form almost no item in the food of these Lizards, since they are so very small, and in the absence of vertebrate animals from their stomachs they verify the justifiable belief that in this State they feed upon no creatures higher than those belonging to the insect world.

In literature, and by correspondence, occasional reports have reached us concerning lizards in warmer climates having eaten Vertebrates such as other lizards, serpents, mice or even small birds, but it must be remembered that such reports come from portions of the country where lizards reach a very much greater size than they attain in the State of Pennsylvania. While such feats may be possible for the larger individuals, it is scarcely to be expected for those that are no larger than the specimens that we have seen representing the lizard of the latitude of Pennsylvania.

In referring to the variations of the size of lizards according to the latitude, it appears worth while to put into publication, and thus on record, the suggestion that specimens of the same species of lizards and perhaps of other reptiles, remain much smaller in size than do the representatives of the same species from the southern or warmer portion of the country. Measurements of the specimens which we have seen in the northern regions compared with the measurements recorded for the southern specimens of the same kind give proof of this. The decrease of size in reptiles of the same species as we proceed northward is only in harmony with the natural laws and conditions observed in other organisms. In going northward even plants become greatly stunted. There is no reason why the decrease in size of reptiles could not be attributed to the natural working of the laws of Nature, limiting their growth and the amount of heat and food to be obtained as they extend into the northern regions, where the warm season is less prolonged, and the amount of heat during the summer is considerably reduced, and where the food becomes more scarce. These factors certainly would tend toward the production of smaller individuals.

Of course, with all reptiles, as with fishes, the kind of food is liable to change with the size of the creature, and thus there may be a variation in economic influence due to the size, which would in turn be due to the latitude and temperature.

Analytic Key to the Families of Pennsylvanian Lizards.

A. Tongue covered with scale-like points (papillae).

B. Tongue long, free or not bound down at front and side, with a very shallow and but slight notch in front; bony plates underlying the scales; Family I. Scincidae. The Skinks.

BB. Tongue shorter, free in front, but bound down at the sides; a deep notch and two long points in front; no bony plates under the scales. Family II. Teiidae. The Striped Lizards.

AA. Tongue covered with very close-set, small, soft points (papillae) like fine velvet, thick, only slightly free around the edges, and but slightly notched in front. Family III. Iguanidae. The Iguanas.

FAMILY I. SCINCIDAE. THE SKINKS.

Different species of Skinks vary in form from short and stout to long and worm-like. The tongue is thin, black, moderately long, free, slightly notched in front and covered with overlapping scale-like papillae or points. The head is covered with regular symmetrical shields or plates. The scales are smooth and supported by bony plates beneath them.

About sixty genera are known, including about two hundred species only thereof which are known to occur in Pennsylvania. These are to be distinguished by the following Analytic Key:

Key to the Species of Pennsylvania Skinks.

A. Palate with teeth, with two slits, one from each nostril; ear large, front edge toothed. Genus Eumeces.

B. Body with five yellowish streaks; scales in twenty-eight to thirty-four rows along the body. 1. *Eumeces fasciatus.* The Five-lined Skink.

BB. With four yellow stripes; scales in twenty-four rows around the body. 2. *Eumeces anthracinus.* The Black Skink.

AA. Palate toothless, cleft by a single slit in the middle; ear very large, circular. Leiolopisma. 3. *Leiolopisma laterale* (Say.). The Ground Lizard.

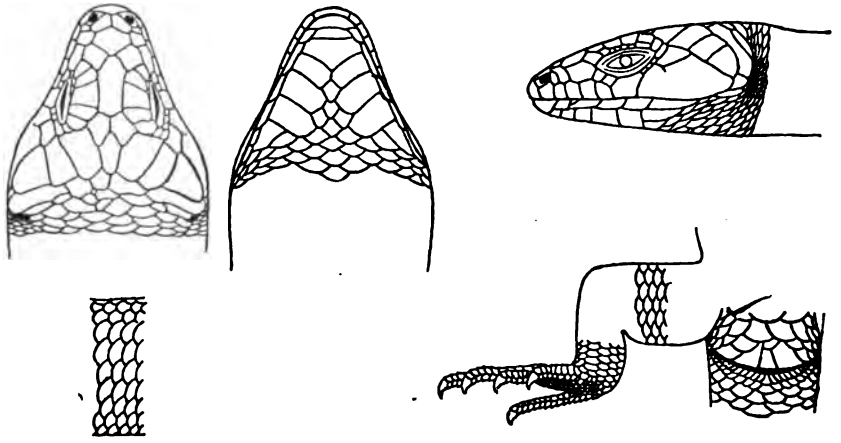

Fig. 26. Blue-tailed Lizard (*Eumeces fasciatus* Linn.). Dorsal, ventral and lateral views of head; and arrangement of scales on side of body and on hind leg and base of tail, ventral view. Kindly loaned by Prof. S. R. Morse, Curator of the N. J. State Museum, from his Ann. Rep. 1906.

Plate XXX. Red Triton (*Spelerpes rubes* Daud.). Adult, nearly nat. size. Photographed from life, under water, by Dr. R. W. Shufeldt. To Illustrate a Salamander.

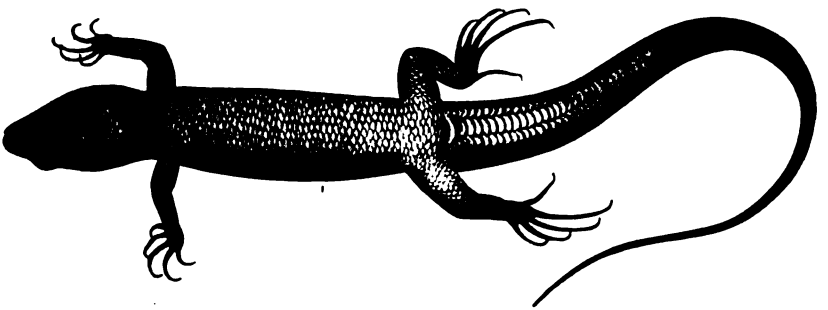

Plate XXXI. Blue-tailed Lizard (*Eumeces fasciatus* Linn.). Dorsal and ventral views. Kindly loaned by Prof. S. R. Morse, Curator of New Jersey State Museum, published in his "Annual Report for 1906."

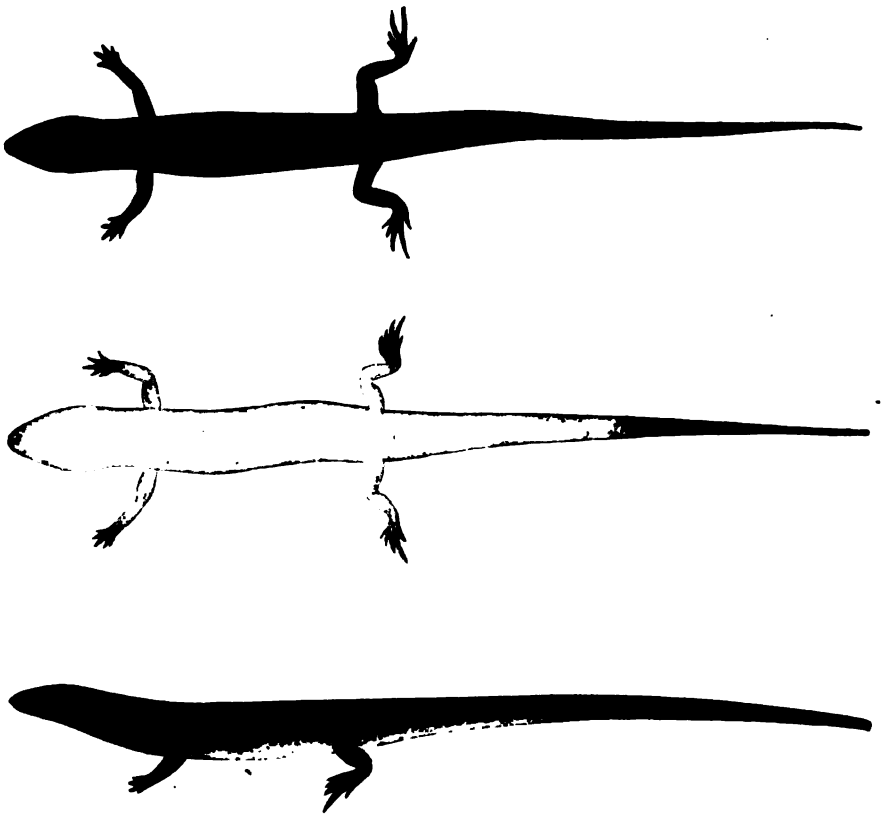

Plate XXXII. Ground Lizard (*Leiolopisma laterale* Say). Dorsal, ventral and side views. Kindly loaned by Prof. Morse, Curator of the N. J. State Museum, published in his "Annual Report for 1906."

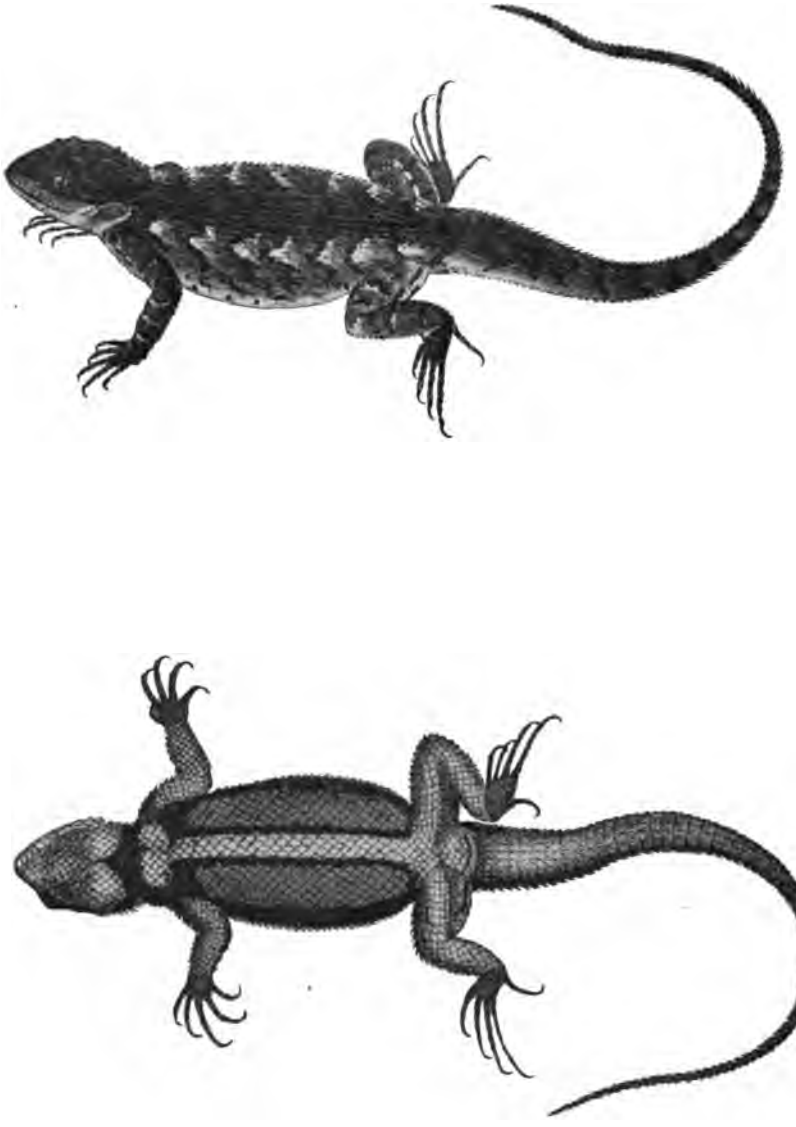

Plate XXXIII. Common Lizard (*Sceloporus undulatus* Daud.). Dorsal and ventral views. Kindly loaned by the N. J. State Museum, published "in Annual Report for 1906."

No. 1. *Eumeces fasciatus* (Linnaeus). **The Five-lined Skink.**

This little Lizard is known by the various names of the Blue-tailed Lizard, Blue-tailed Skink, Five-lined Lizard, Five-lined Skink, Red-headed Lizard, Red-headed Skink, Striped Lizard, Striped Skink, "Scorpion" and Blue Skink. It is probably due to its remarkable quickness of movement that the expression has originated, "As quick as a blue streak." The proper expression shoud doubtless be, "As quick as a bue skink." It is, of course, wrongly called the "Scorpion," as this term should apply only to spider-like crustaceans or invertebrates.

The Five-lined Skink is found in the United States from Massachusetts and Northern Indiana to the Rocky Mountain region inclusive, and southward over the Eastern and Central States.

What few specimens have been received by us have been from widely different parts, showing the possibility of its being found over practically the whole State of Pennsylvania; although it is rare; and where it occurs it is often not seen excepting by persons making a special effort to search for it. Our collections of this species are as follows:

Centre county,	Surface, H. A.,		State College.
Clarion county,	Heffner, H.,		5.8 Leeper.
Dauphin county,	Shuey, J. A.,	(a) 3 (b)	2.3 Penbrook.
Montour county,	West, Mrs. G. P.,		Danville.
St. Tammany Co., La.,	Geist, Karl,		5.6 Covington, La.
Mecklenburg Co., Va.,	Van Sant, Miss Belle,		5.0 George School, Pa.

The Five-lined or Blue-tailed Lizard is described as being black or yellowish with five yellow streaks, the middle one forked on the head, the tail usually light blue, older specimens reddish olive, the stripes very faint or sometimes missing; head becoming coppery red with age. While it is yet young or not more than four or five inches long the lines are plainly visible, but as it becomes older, these are lost in the males, while the females retain the distinct stripes throughout life. The males become a uniform dull olive brown on the body, with bright red about the head. This gives the explanation to the common name, "Red-headed Lizard." The change in the color as this reptile increases in size and age has caused some writers to describe it under different specific names when found representing different ages. It attains a length of eleven inches, while the largest we have in our collection is about six inches in length. Its largest size is reached in the Southern States, while in Pennsylvania, New York and New Jersey the average size of a mature specimen is about six inches.

Owing to its extreme rapidity it is one of the most difficult creatures to capture, and for that reason often escapes collectors, when other creatures of the same region would be taken more abundantly. The one which we collected in Centre county was on a post near an

old saw mill, and after wrapping the entire post from bottom to top in a sheet of mosquito netting, it was enclosed within the netting and even then by a sudden dash managed to escape through a chance opening which it saw, and the collector found it necessary to wait until the next day when it reappeared upon the same post and was shot with dust shot. Ditmars says of this species, "The reptiles invariably bask or hunt for insect prey within a short distance of secure hiding places, such as a burrow under a fallen tree or a cavity in the trunk. Unlike many species of lizards that run for an indefinite distance when disturbed, then stop and peer back at the object of their fright, the Skink flashes out of sight at the slightest shadow. As it emerges from its burrow it looks cautiously about to ascertain whether all danger is past and the movement of a finger will send it back again."

These Lizards often ascend trees, and in fact the older ones appear to spend considerable time there. Holbrook says, "They choose their residence in deep forests and are commonly found about hollow trees, often at a height of thirty or forty feet from the ground; sometimes in the last year's nest of a woodpecker, out of which he thrusts his bright red head in a threatening manner to those who disturb his home. He never makes his habitat on or near the ground, and in fact seldom descends from the elevation unless in search of food or water. Although shy and timid he is very fierce when taken, and bites severely." The bite is not venomous and there is really no reason to fear it in the least. It is the older individuals that live mostly in the trees, while the younger ones live mostly in hollow stumps and under bark of decaying logs. They winter beneath the loose bark of trees where they may be found dormant, in company with other creatures hibernating in such places.

They reproduce by laying from four to nine oval eggs beneath loose bark and around which the female coils during the several weeks that they are incubating, but when the young emerge the parents pay no further attention to them (Ditmars).

The Skink feeds wholly in the daytime and finds concealment toward evening. Ditmars says, "The Skink is strictly diurnal, seeking its hiding place with the setting of the sun. Its food consists largely of insects, but well-grown specimens will feed upon the eggs of birds, or newly born wood mice, often discovered by the lizard as it investigates the crevices of fallen trees." Other writers have reported the food of this Lizard as follows:

"It will feed largely on the house fly."—Dr. Abbott.

"Food consists of insects."—Hay.

"One kept in captivity ate a number of wood mice" (Oniscus). It gorged itself with these and afterward died from wind colic."—Cope, in his "Crocodiles, Lizards and Snakes of North America." page 638.

Our specimens and records have shown that one specimen contained food, and this was a measuring worm or span worm, similar to the Canker Worms, being the larva of a Geometrid moth. This at least indicates the decidedly beneficial quality of this species of animal.

No. 2. *Eumeces anthracinus* (Baird). **The Black Skink.**

This little Lizard occurs in the mountainous or hilly districts from Pennsylvania to Texas, being most abundant in the Allegheny Mountains. In the State of Pennsylvania it was collected by its discoverer, Prof. S. F. Baird, near Carlisle, Pa., which is the origin of the type. It is rare in this State. The specific name "Anthracinus" means "coal-black," and refers to the color of the reptile, which has a coal-black band along the back. For this reason it is sometimes called the Black-backed Lizard. It is a dark olive green on the back with two distinct white lines on each side, while in the centre of each pair of stripes and bordering above them is a coal-black band. Below the lower stripe the color is olive. The head of the adult is reddish, but there is no great difference between the young and mature in colors.

The Black Skink has the scales in twenty-four rows around the body, and the form of the body is elongate and cylindrical. The total length is five and one-half inches, including the tail, which is about three inches long. Since this belongs to the same genus as the Blue or Five-lined Skink, the habits are no doubt very similar. It likewise feeds on insects and must be regarded as beneficial.

No. 3. *Leiolopisma laterale* Say. **The Ground Lizard.**

The generic or first name of this species refers to the smooth scales, and the specific or second name refers to the band along the side. We have not been fortunate enough to collect specimens of this species in Pennsylvania, but we have seen a specimen No. 3550, in Cornell museum, whichwas collected on the Caroline Hills near Ithaca, N. Y., April 13, 1892, by Messrs. W. J. Terry and Louis A. Fuertes. While it is abundant in the Southern States it is evidently rare in Pennsylvania, although it is to be found in this State. It occurs from New York southward through Florida and westward to Southern Illinois and into Mexico. It is called the "Ground Lizard," because of its habits of living on or near the ground, and in fact it is a burrowing species, often found beneath leaves. It is also called the Brown-backed Skink or Brown-backed Lizard, because of the color of its back, and Black-banded Lizard, due to the color of the dark band on its side. It is a very small, elongate Lizard, with quite small limbs, and more truly resembles a Salamander than does any

other Lizard. The back is chestnut or brown in color, while on each side there is a band edged with white. The abdomen is yellowish, the tail blue below and the head is short. The length of a mature specimen is about five inches.

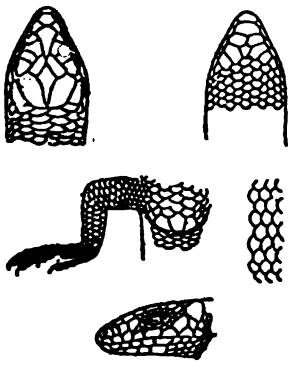

Fig. 27. Ground Lizard (*Leiolopisma laterale* Say). Kindly loaned by Prof. Morse, Curator of N. J. State Museum, from his Ann. Rep. 1906.

"In some portions of the Southern States this species of lizard is abundant. Holbrook says they might in his day be seen by thousands in the thick forests of oak and hickory of Carolina and Georgia. They emerge from their retreats after sunset, in search of small insects and worms on which they live; yet they appear and disappear so rapidly that they might at first be mistaken for crickets or other insects. It is difficult to secure them alive. They conceal themselves rapidly under roots or beneath leaves. It is said to breed in Georgie in March."—Hay. It is known that this Lizard feeds on insects on the ground in forests after night and has no objectional qualities. It is, therefore, proven to be beneficial and worthy of protection. "Although well protected by its sombre hues, these closely matching the ground, the Brown-backed Lizard has many enemies in the shape of snakes, particularly the young of the genus Ophibolus; the Scarlet Snake also feeds largely upon it. The Ground Lizard thrives in captivity if provided with an abundance of the proper food—ants, their larvae, and the grubs of smaller wood-boring bettles."—Ditmars.

FAMILY II. TEIIDÆ. THE STRIPED LIZARDS.

The animals of this family may be known by the flat, thin tongue ending in two long points. Its surface is mostly covered with overlapping scale-like projections or papillae. There are no bony

plates under the scales, as in the preceding family. Belonging to the family of Striped Lizards there are about one hundred and ten species, nearly all from Tropical America, but one occurs as far north as this State.

No. 4. *Cnemidophorus sexlineatus* (Linneaus). **The Six-lined Lizard.**

This Lizard is variously known as the six-lined Lizard, Sand Lizard, Sand Trotter, Sand Skeeter, Sand Sister and the Long-tailed Swift. The first or generic name means "wearing leg armour," and the second or specific portion of its scientific name refers to the six lines found on its body.

It is found from Connecticut to Florida and westward to California, northward to Nebraska and Wisconsin, while in its southern range it extends into Mexico. It is distinctly brown, with three yellow streaks on each side and the spaces between the lines jet black. The throat is silvery, while the under side is blue in the males. There is a greenish stripe on the back of the thigh at each side, prolonged on the tail. The older individuals are about the same color as the younger. It attains a length of not more than ten inches.

The Six-lined Lizard is one of the ground-inhabiting Lizards, rarely climbing trees, but frequenting dry sandy places. They dig burrows in which they pass the night and in which they find protection when pursued. The are remarkably swift when on the ground, and being keen eyed are able to escape a pursuer without great difficulty.

Some writers have written of the food of the Six-lined Lizard as follows:

"Its food is principally insects. Dr. Coues saw it catch flies in a tent."—Hay.

"It can run with such speed that no insect, not even the wary Tiger beetle, can escape it except by flight. It lives upon grasshoppers, cock roaches, tiger beetles and other beetles."—Hartman, in "Transactions of Kansas Academy of Sciences."

"For the most they are insectivorous, but the adults are not averse to feasting upon the eggs of small birds that build their nests on the ground. The Lizard cracks the shell with its strong jaws and laps up the contents with the long, flat forked tongue. All of the species lay thin-shelled eggs. The female scoopes out a hollow in the sand and, carefully covering the eggs, leaves them to be hatched by the sun's heat."—Ditmars.

FAMILY III. IGUANIDAE. THE IGUANAS.

The Lizards belonging to this family are to be recognized by the thick tongue, almost entirely fixed to the floor of the mouth, and

by the little notches in front, without scales, but with only very fine papillae. This is a large family of three hundred and twenty species, found mostly in the hotter parts of America, but with one species occurring commonly in the State of Pennsylvania. This belongs to the genus Sceloporus, meaning "leg-pore," referring to some small pores in the legs.

No. 5. *Sceloporus undulatus* (Latrielle). **Common Lizard. Swift.**

This reptile is variously known as the Common Lizard, Brown Swift, Swift, Alligator Lizard, Pine-tree Lizard, Pine Lizard, Brown Scorpion and Fence Lizard. It occurs in the United States in forests

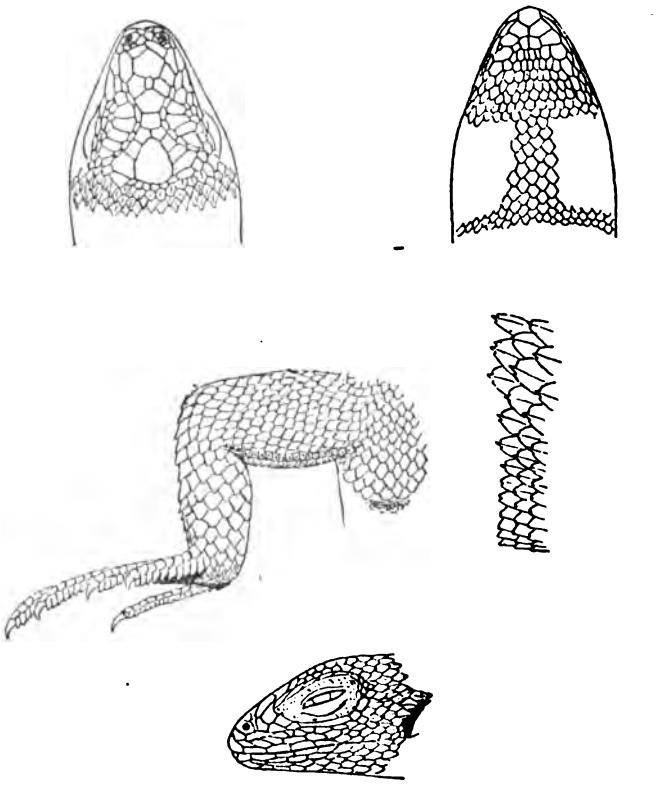

Fig. 28. Common Lizard (*Sceloporus undulatus* Daud.). Kindly loaned by Prof. S. R. Morse, Curator of the N. J. State Museum, from his Ann. Rep. 1906.

and along fences as far north as New York and Michigan, and is very abundant southward. It is found westward to the Pacific Ocean, as far north as Oregon. It is the most common Lizard in Pennsylvania, being found in our collections and contributions as follows: (N. B.—The length is given in inches.)

Length.			
4.6	Berks county, ...	Sternbergh, H. M., ...	Reading.
5.6	Bucks county, ...	Van Sant, Belle, ...	George School.
4.25	Clearfield county, ...	Buck, H. S., ...	Clearfield.
3.0	Dauphin county, ...	Shuey, J. A., ...	Dauphin.
6.4	Dauphin county, ...	Zinn, W. H., ...	Dauphin.
(a) 2.6 (b) 6.0	Dauphin county, ...	Suskey, John C., ...	Harrisburg.
1.1	Dauphin county, ...	Urich, D. C., ...	Penbrook.
3.2		Phillips, Jos., ...	Williamstown.
5.6	Franklin county, ...	Small, L. B., ...	Marion.
4.4	Franklin county, ...	Atkinson, Mr., ...	Mont Alto.
3.4	Franklin county, ...	McNeal, Jas., ...	Mont Alto.
(a) 5.6 (b) 5.4 (c) 6.6	Fulton county, ...	Mosebey, W. L., ...	Wells Tannery.
6.5	Juniata county, ...	Landis, G. & J., ...	McCulloch's Mills.
5.75	Perry county, ...	Hooke, B. P., Jr., ...	Landisburg.
3.8	Perry county, ...	.....	Landisburg.
5.75	Perry county, ...	Brightbill, H. A., ...	Marshrun.
5.0	Perry county, ...	Brightbill, H. A., Jr., ..	Marshrun.
(a) 6. (b) 3.25	Snyder county, ...	Keller, W. I., ...	Beaver Springs.
3.3	York county, ...	Johnson, J., ...	Woodbine.
6.0	Saint Tammany Co., La.,.	Geist, Karl, ...	Covington, La.
...	Ocean county, N. J., ...	O'Connor, H. J., ...	Tom's River, N. J.
5.0	Mechlenburg Co., Va.,.....	Van Sant, Belle, ...	George School, Pa.
(a) 4 (b) 5.4	Wayne county, W. Va., ..	Van Ostrand, H. T., ...	Bowen, W. Va.

The Swift is greenish, bluish or bronze with wavy cross bands above, often in the shape of irregular "V's." On each side of the back is an indistinct paler band, about ten rows of scales between the two. The males have a black blotch under the chin enclosed in a blue area, and also two large bluish patches on the sides of the abdomen. There is no blue on the under side of the female.

The scales on the back are rather large and very strongly keeled and pointed. In this regard this species differs from all other species of Lizards found in this State. The body is depressed or flattened; the tail slender; the head with large plates on the upper surface; the total length is about seven inches.

The Swift or Common Lizard is found in forests and along fences, rather rarely in the northern and central portions of this State, but much more commonly southward. It not only varies in color, but has the peculiarity of changing its color at will to some extent, somewhat as does the Chameleon of the Southern States, which belongs to the same family. In some parts of this State it is called the Rock Lizard or Log Lizard, for the reason that it is so frequently found on rocks and logs. It may particularly be sought around saw mills where there are logs with loose bark, and where insects are generally present in considerable numbers. In such places the Lizards find not only protection but also food.

We should again emphasize the point that this little reptile is entirely harmless and has no power of inflicting injury whatever, although most persons are deadly afraid of it and regard it with indescribable horror and fear. The Swift is very easily and quickly tamed, and thrives in captivity if kept in a cage entirely dry, given as much sunlight as possible and fed on meal worms and other soft-bodied insects or upon pieces of lean meat cut fine and moved before it on the end of something like a toothpick. We have fed them many times by putting the food on the point of a very small

stick or long pin and moving it before them enough to make it have the appearance of living and moving. They do not feed upon dead or quiet objects.

Ditmars says of them, "Their movements upon a large, fallen tree trunk, were very amusing. When approached they would dart at the opposite side of the trunk to that upon which one was approaching. As the collector's body loomed over the trunk the Lizard would shift its position until it was directly beneath. If every movement of one's approach were slow and cautious, capture was comparatively simple, for all to be done was to make a rapid grab with the hand on the opposite side of the log from that on which the bulk of the collector's body appeared. But alas! This grab could not be regulated to the nicety as if you were actually looking at your object, and, although the hand approached with lightning-like rapidity, the lizard started away from it at the same rate. The result was, in many cases, that you did grasp the creature, but by the tail. A second later a dark object scurries over the sand in direct line for a tree, and up it darts, while you ruefully examine a wriggling tail from which the original owner had twisted itself free.

"The eggs of this species are from three-eighths of an inch to one-half inch in length according to the size of the female. They are oval and covered with a very thin papery shell; it is indented upon the slightest pressure of the fingers. The eggs may be hatched by placing them in moderately damp, not soggy, sphagnum moss, and keeping them in an ordinary room temperature, where their period of incubation is from six to eight weeks. Concerning the reproduction of this Lizard, Dr. Hay adds, "The eggs are said to be laid in the sand, probably in little groups. They are deposited about June first, and are hatched about July 10th. The eggs are long and narrow, are covered with a tough coate, and are without any calcareous material. The egg weighs about twenty grains. They are abandoned to their fate, but when the young are hatched they are treated with the utmost gentleness by all the adults."

Smith in his "Report of the Reptiles and Amphibians of Ohio," says, "The swift probably hibernates beneath old bark. It does not become adult until two years of age. In Georgia it breeds in April."

In another publication by Eckel and Paulmier, of the University of the State of New York, Bulletin No. 57, the authors say, "Its eggs, which are long and narrow, are laid in the sand about June 1st, and hatched about July 10th."

Concerning the food of the Swift, authors have written as follows:

"It feeds on insects about the bark of trees, about logs and on fences."—Fowler in the N. J. State Museum Report, 1906.

"Their food consists of flies, ants, small spiders and the like. Abbott came to the conclusion that their vision is not acute, while their hearing is more searching. In endeavoring to catch flies they often missed their aim, although the insects were within their easy reach."—Hay.

"This lizard abounds in sandy regions, especially along streams. Examinations of five individuals showed that they had eaten grasshoppers (mostly nymphs), ground beetles and leaf hoppers."—Hartman.

Our examination of the food of the common Swift shows results as follows,—the first number being the number of the individuals of this species containing the respective kind of food mentioned, and the second number is the percentage which were found feeding upon this respective material in reference to the total number examined:

	No.	Per cent.
Mollusca—Snails,	3	12
Arthropoda:....		
Crustacea—Oniscidæ, "Sow Bugs,"	1	4
Arachnida—Spiders,	5	20
Insecta,	25	100
Undetermined Insects,	9	36
Plecoptera—Perlidæ, Stone Flies,	1	4
Orthoptera, Grasshoppers, etc.,	6	24
Acrididæ, Short-horned Grasshoppers,	5	20
Undetermined species,	1	4
Malanoplus sp., Grasshopper,	2	8
Melanoplus femur-rubrum, Red-leg,	1	4
Tetix sp., Small Grasshopper,	1	4
Locustidæ—Atlanticus sp., Grasshopper,	1	4
Gryllidæ, Crickets,	2	8
Gryllus sp.,	1	4
Gryllus pennsylvanicus, Pa. Cricket,	1	4
Hemiptera, Bugs,	3	12
Heteroptera,	3	12
Undt.,	1	4
Pentatomid Undt., Stink Bugs,	1	4
Podisus sp.,	1	4
Lepidoptera,	7	28
Undet.,	1	4
Undet., larvæ	4	16
Geometridæ, Measuring Worm,	1	4
Noctuid larvæ, Cutworms,	2	8
Diptera—Undet. sp., Flies,	1	4
Coleoptera,	15	60
Undet.,	11	44
Larvæ,	2	8
Staphylinidæ, Rove Beetles,	1	4
Elateridæ,	3	12
Nitidulidæ—Ips quadriguttatus,	1	4
Chrysomelidæ, Leaf Beetles,	1	4
Chrysomela sp.,	1	4
Hymenoptera,	8	32
Undet sp.,	4	16
Ichneumonidæ—Undet.,	3	12
Myrinicidæ—Undet.,	1	4

From a study of the above table we get the new and interesting point that snails may constitute a very high percentage of the food of these Lizards, and at the same time they are decidedly insectivorous, feeding upon insects, belonging to different families, and

often taking insect larvae. Thus the value of this despised Lizard is distinctly proven and the recommendation is given to preserve these creatures for their beneficial services.

LIST OF REFERENCES FOUND IN THIS BULLETIN.

1882, Dr. Smith, "Report of Reptiles and Amphibians of Ohio," from Report of Geol. Survey of Ohio, Vol. IV., Part 1, Zoology, Columbus, Ohio.

1892. Dr. O. P. Hay, "The Batrachians and Reptiles of the State of Indiana," Department of Geology and Natural History, Resources of the 17th Annual Rept. (for 1891), Indianapolis, Ind.

1900, Dr. E. D. Cope, "The Crocodilians, Lizards and Snakes of North America," Smithsonian Institution, U. S. N. M., Washington, D. C.

1902, Eckel & Paulmier, "N. Y. Reptiles and Batrachians," Univ. of State of N. Y., Albany, 1902.

1905, C. W. Nash, "Check List of Reptiles," "Batrachians and Mammals ofOntario," Department of Education, Toronto, Ont.

1906, W. Stone, "Notes on Reptiles and Batrachians of Penna.," N. J. and Del., Am. Nat. XL., 1906, p. 159-170.

1906, F. A. Hartman, Wichita, Kansas, "Food Habits of Kansas Lizards and Batrachians," Tr. Kas. Sc. Sci., XX., pt. 2, Dec., 1906.

1907, Henry W. Fowler, "A Report of the Amphibians and Reptiles of New Jersey," Annual Report of the New Jersey State Museum for 1906, Trenton, N. J.

1907, R. L. Ditmars, New York, "The Reptile Book." 8 color plates, 400 photographs from life and 472 pages.

ACKNOWLEDGMENT OF SPECIMENS RECEIVED BY THE ECONOMIC ZOOLOGIST.

We take pleasure in acknowledging the following contributions of specimens:

SPECIMENS RECEIVED DURING OCTOBER, 1907.

For each entry of which the species is determined a common name is given, followed by the scientific name. Following entries are given with the common name when that is definite and with the scientific name when the common name is not a definite name, allowing the contributor to trace the list back for the scientific name as given where first mentioned.

Number.	Specimen.	Date—October, 1907.	Name and Address.
	Insecta.		
10913	(b) Morning Sphinx (Deilephila lineata), (c) Milkweed Caterpillar (Euchaetias egle),	1	W. O. G. West, Danville.
10914	Hickory Horned Devil (Citheronia regalis),	1	H. H. Hawkins, Spring Forge.
10915	Mole Crickets (Gryllotalpa sp.),	1	W. R. Rohm, Harrisburg.
10916	Pine Leaf Scale (Chionaspis pinifolii),	1	S. N. Baxter, Wenonah, N. J.
10917	Hickory Horned Devil,	1	A. H. Stevens, Enid.
10920	Beetle larva,	1	M. L. Sheetz, Harrisburg.
10926	Hag Moth larvæ (Phobetron pithecium),	2	A. J. Snyder, Greencastle.
10928	(a) 15-spotted Lady Beetle (Anatis ocellata), (b) Clover Weevil (Phytonomus punctatus),	2	Mrs. M. M. Hildebrant, Mt. Joy.
10929	Sphinx larva,	2	L. M. Simmons, Linglestown.
10931	Broad-winged Katydid (Cyrtophyllus perspicillatus),	2	A. E. Fisher, Duncannon.
10932	(a and b) Plant Lice, (c) Book Lice, (d) Collembola, (e) Fly larva,	2	Mr. Witman, Cornwall.
10925	Warble Fly Larva,	2	C. S. Ebersol, Mechanicsburg.
10939	(b) Parasitized Aphids,	3	R. C. Beaver, Greenville.
10941	Hag Moth larvæ,	3	Miss L. Bruner, Denver.
10942	Aphids,	3	T. Wood, Harrisburg.
10943	(a) Io Moth larvæ (Hyperchiria io) (b) Saddle-back Larva (Sibine stimulae),	3	C. A. Reichle, York.
10944	(a) 5-spotted Sphinx (Phlegethontius 5-maculata), (b) Milkweed Butterfly (Danais plexippus),	3	J. E. Degler, Tulpehocken.
10945	(a) Sphinx larva (pholus pandorus), (b) Moth larva (Noctuidae), (c) Tachina Fly larvæ,	3	G. B. Croop, Tunkhannock.
10946	Pholus pandorus larvæ,	3	Miss M. Whiteman, Reading.
10947	(a) Io larvæ, (b) Polyphemus larvæ (Telea polyphemus), (c) Imperial Moth larvæ (Eacles imperialis), (d) Promothea larva (Callosamia promothea),	3	S. Baldy, Catawissa.

SPECIMENS RECEIVED DURING OCTOBER, 1907.—Continued.

Number.	Specimen.	Date—October, 1907.	Name and Address.
10948	Lappet Moth (Tolype velleda),	3	F. W. Kolb, Easton.
10949	P. pandorus larva,	3	L. C. Long, Listie.
10951	14 species of insects,	4	S. Baldy, Catawissa.
10953	(b) Bird Lice,	4	A. F. Boettcher.
10957	Eggs of Geometrid Moth,	4	H. F. Walker, Elkland.
10958	(a) Hag Moth larva, (b) Parasitized Moth larva,	4	A. Hile, Curwensville.
10960	Imperial larva,	4	Prof. G. P. Singer, Lock Haven.
10961	Long-horned Grasshopper,	4	G. Mall, Harrisburg.
10966	Drone Fly (Eristalis tenax),	5	A. B. Miller, Barnesville.
10967	Noctuid larva,	5	Mrs. J. W. Stang, Springville.
10968	(a) Arctiid larva, (b) Arctiid larva, (c) Rosy Maple Worm (Dryocampa rubicunda),	5	Mrs. J. W. Atkinson, Buckingham.
10978	Oyster-shell Scale (Lepidosaphes ulmi),	7	J. R. Snavely, Harrisburg.
10979	Milkweed Butterfly chrysalis,	7	W. R. Klinger, Valley View.
10980	Oil Beetle (Meloe americanus),	7	H. Likert, Blacklick.
10981	(a) Oil Beetle, (b) Milkweed Butterfly Chrysalis,	7	G. F. Hurr, DuBoistown.
10991	Walking Stick (Diapheromera femorata),	8	A. B. Geary, Wallingford.
10993	Saddle-back Larva,	8	J. W. Fox, Mt. Pleasant.
10995	6 species of insects,	8	F. M. Bream, Gettysburg.
10996	(a) Sphinx Larva (Sphinx drupiferarum), (b) Moth larva,	8	H. Van Waltersdorf, Hanover.
10997	(a) Bird Fly, (b) Saddle-back larva,	8	M. B. Bergey, Souderton.
10998	(b) Imperial larva,	8	Dr. W. W. Climenson, Honey Brook.
10999	Bag Worm (Thyridoptery ephemeraeformis),	8	J. C. Knox, Gettysburg.
11000	(a) Oil Beetle, (b) Stink Bug (Pentatomidæ), (c) Lady Beetle (Megilla maculata),	8	H. K. West, Danville.
11001	Cicada,	8	F. Slaser, Harrisburg.
11008	(a) Imperial larva, (b) Moth eggs,	9	Mrs. J. W. Atkinson, Buckingham.
11009	Soft Scale (Eulecanium cerasifex),	9	W. H. Bullock, Honesdale.
11011	Terrapin Scale (Eulecanium nigrofasciatum),	9	B. F. Evans, Berwick.
11012	Cadelle larva (Tenebrioides mauritanica),	9	Mrs. E. O. Sanborn, Erie.
11013	Gold Beetle (Coptocycla signifera).	9	J. W. Leibengood, Harrisburg.
11015	Imperial Moth pupa,	9	L. M. Simmons, Linglestown.
11016	Larva of ten species of insects,	10	S. Baldy, Catawissa.
11022	San José Scale (A. perniciosus),	10	B. Brace, Keelersburg.
11023	Scurfy Scale (Chionaspis furfurus),	10	J. E. Jamison, Mines.
11025	Cicada,	10	Miss M. E. Zimmers, Bedford.
11026	Fig-eater (Allorhina nitida),	10	W. B. Ridenour, Scranton.
11027	Hemisphaerical Scale (Saissetia hemisphaerica),	10	B. A. Boyer, Mandata.
11028	Wheel Bug (Prionidus cristatus),	10	D. Metz, Harrisburg.
11029	Cicada,	10	D. W. Post, Towanda.
11033	Aphids,	12	H. Inman, Philadelphia.
11034	Stink Bugs,	12	W. D. Dixon, St. Thomas.
11035	San José Scale,	12	J. H. McLanahan, Hollidaysburg.
11036	Tachinid Fly larva,	12	Miss N. Biles, Wyalusing.
11037	(a) Arctiid Moth Larvæ, (c) Sawfly Larvæ, (d) Phycid Moth larvæ,	12	Miss M. L. Dock, Fayetteville.
11044	Collection of 13 species of insect larvæ,	14	Dr. W. W. Climenson, Honey Brook.
11045	(b) Bird Louse,	15	R. W. Wehrle, Indiana.
11046	Imperial Larva,	15	E. C. Atkinson, Buckingham.
11047	Aphids,	15	W. B. Davis, Philadelphia.
11048	(a) Lappet Moth, (b) Limacodid Moth Larva, (c) Cicada,	15	D. J. Weber, Meadville.
11049	(a) Dragon Fly Larva, (b) Backswimmer (Notonecta undulata), (c) Water Beetle (Dineutes discolor), (d) Water Boatmen (Corisidæ),	15	E. E. Sensenig, Emaus.
11052	San José Scale,	16	W. H. Sweitzer, Stewartstown.
11053	(c to g) 5 species of insects,	17	J. J. Palmer, Greenville.

SPECIMENS RECEIVED DURING OCTOBER, 1907.—Continued.

Number.	Specimen.	Date—October, 1907.	Name and Address.
11057	San José Scale,	17	N. B. Cooper, Slatehill.
11058	(a) San José Scale, (b) Scurfy Scale,	17	J. Waltman, Bethlehem.
11059	Maple Pseudococcus (Pseudococcus aceris),	17	Miss A. M. Deers, Pittsburg.
11060	Oil Beetle,	17	N. S. Brown, Springville.
11062	Aphids,	17	H. W. Lush, Galeton.
11067	Katydid Eggs,	18	H. C. Baldwin, Berwyn.
11069	Mole Cricket,	18	F. V. Brayman, Blooming Valley.
11071	Oyster-shell Scale,	18	R. H. Kell, Blain.
11076	(c) Cecropia larva (Samia cecropia)	19	S. S. Carpenter, Ulysses.
11077	5-spotted Sphinx,	19	M. M. Hall, Fleming.
11078	Oyster-shell Scale,	19	A. M. Ryan, Towanda.
11079	Moth larva (Harrisimenna trisignata),	19	C. F. Harbaugh, Sewickley.
11080	(a) Walking Stick,	19	J. E. Senft, Hanover.
11081	(a) Io larva, (b) Dark Moth (Feltia subgothica),	21	Rev. W. H. Pickop, Pine Grove.
11087	Wooly Aphis,	22	D. H. Bauman, Munhall.
11088	Parasitic Hymenoptera cocoons,	22	W. H. McElwee, Harrisburg.
11090	Walking Stick,	22	B. D. Latshaw, Dornsife.
11096	Papilio turnus larva,	24	W. A. Warner, Pineville.
11097	(a) Butterfly Chrysalis, (b) Cecropia cocoon,	24	Mrs. J. W. Stang, Springville.
11098	Aphids,	24	C. B. Culp, Schellsburg.
11099	Katydid Eggs,	24	C. S. Mills, New Castle.
11101	Mole Cricket,	25	J. A. Faust, Shippensburg.
11105	Oyster-shell Scale,	26	J. R. Turner, Sanatoga.
11106	Oestrid fly warble,	26	P. M. Crane, Towanda.
11110	Walking Stick,	28	H. Behler, Pittston.
11111	Hemisphaerical Scale,	28	C. A. DeLong, Eaglesmere.
11112	San José Scale,	28	J. K. McLanahan, Hollidaysburg.
11118	(a) Work of Codling Moth (Carpocapsa pomonela), (b) Beetle larvæ (Apion),	29	J. C. Snyder, Boardman.
11119	(a) Aphids, (b) Scurfy Scale,	29	J. M. Schenck, Enid.
11121	Sphinx Larva,	29	Miss E. M. Gilmore, Buckingham.
	Invertebrates Not Insects.		
10918	Red Mites,	1	E. Wells, Wilkes-Barre.
10930	Millipedes,	2	H. M. Dellinger, Paradise.
11932	Millipedes,	2	Mr. Witman, Cornwall.
10953	(c) Mites,	4	A. F. Boettcher, Rolands.
10956	Mites,	4	J. R. Armont, Plainsville.
10959	Lycosid Spider,	4	L. B. Cushman, North East.
10968	(d) Spider,	5	Mrs. J. W. Atkinson, Buckingham.
11003	(b) Cray fish (Cambarus sp.),	9	J. Pruss, Harrisburg.
11014	Spider,	9	L. R. Metzger, Harrisburg.
11037	(b) Epeirid spider cocoon,	12	Miss M. L. Dock, Fayetteville.
11051	Mites,	16	W. J. Hallowell, Hallowell.
11053	(h) Spider,	17	J. J. Palmer, Greenville.
11061	(a) Centipede,	17	J. B. Swaney, Hookstown.
11068	Earthworm,	18	D. H. Bauman, Munhall.
11070	Spider,	18	E. R. Mulford, Wellsboro.
11080	(b) Spider,	19	J. E. Senft, Hanover.
11092	Spider,	22	C. D. Vorhees, Somestown.
	Reptiles, Batrachians and Fishes.		
10907	2 Common Water Snakes (Natrix sipedon),	1	L. Yoder, Harrisburg.
10908	Musk Turtle (Aromochelys odoratus),	1	S. H. Derickson, Danville.
10909	(a) Queen Snake (Regina leberis), (b) Green Frog (Rana clamitans), (c) Leopard Frog (Rana pipiens), (d) Cave Salamander (Spelerpes longicauda),	1	J. Couch, Cannonsburg.
10910	Sculptured Turtle(Clemmys insculptus),	1	R. W. Wehrle, Indiana.
10911	(a) Newt (Diemictylus viridescens), (b) Land Salamander (Plethodon cinereus),	1	John Lawrence, Coatesville.
10912	(a) 2 Land Salamanders,	1	W. O. G. West, Danville.
10923	Common Garter Snake (Thamnophis sirtalis),	1	H. K. Peters, Belleville.
10929	2 Common Garter Snakes,	1	Dr. C. Westbrook, Harrisburg.

SPECIMENS RECEIVED DURING OCTOBER, 1907.—Continued.

Number.	Specimen.	Date—October, 1907.	Name and Address.
10924	Sculptured Turtle,	1	W. F. Stevens, Sterling.
10925	House Snake (L. d. triangulus),	2	M. M. Sweesy, Walker Lake.
10935	Common Box Tortoise (Terrapene carolina),	3	R. W. Wehrle, Indiana.
10936	Common Water Snake,	3	A. S. Kreider, Jr., Annville.
10937	(a) Common Water Snake, (b) Pilot Snake (callopeltis obsoletus),	3	Prof. I. L. Kinney, Portland.
10939	(a) Queen Snake,	3	R. C. Beaver, Greenville.
10950	Common Rattle Snake (Crotalus horridus),	4	G. W. Bowser, Shirleysburg.
10952	Sculptured Turtle,	4	A. A. Northrop, Brown Sta., N. Y.
10954	Common Garter Snake,	4	D. Bohn, Altoona.
10955	Red-bellied Snake (Storeria occipitomaculata),	4	L. V. Workman, State College.
10962	(a) 2 Queen Snakes, (b) Cave Salamander, (c) Common Toad (Bufo l. americanus),	4	Greenville High School, Greenville.
10963	(b) Painted Turtle (Chrysemys picta) (c) Blowing Viper (Heterodon platirhinos),	4	Pro I. L. Kinney, Portland.
10964	5 Sculptured Turtles,	5	R. W. Wehrle, Indiana.
10965	Red-bellied Snake,	5	H. R. Hammerle, Wilkes-Barre.
10969	Common Water Snake,	7	C. S. Ebersol, Mechanicsburg.
10971	Newt,	7	Dr. W. W. Climenson, Honey Brook.
10972	Newt,	7	J. K. Johnson, McConnellsburg.
10973	Common Garter Snake,	7	J. T. Blake, Fox Chase, Philadelphia.
10976	(a) 6 Blowing Vipers, (b) 40 Young House Snakes,	7	R. A. Blaksley, Weatherly.
10977	Hellbender (Cryptobranchus alleganiensis),	7	Miss G. Carn, Harrisburg.
10987	2 Blowing Vipers,	8	E. E. C. Gibbs, Huntingdon.
10989	Common Garter Snake,	8	A. C. Dearer, Catawissa.
10990	2 Granite Salamanders (Plethodon glutinosus),	8	C. E. Gere, Kingsley.
10992	Blowing Viper,	8	W. S. Tompkins, Eatonville.
10994	Land Salamander,	8	A. F. Kreider, Annville.
10998	(a) Varied Tree Frog (Hyla versicolor),	8	Dr. W. W. Climenson, Honey Brook.
11003	(a) 2 Common Garter Snakes,	9	J. P. Russ, Harrisburg.
11004	Common Box Tortoise,	9	S. Baldy, Catawissa.
11005	Common Garter Snake,	9	J. T. Blake, Fox Chase, Philadelphia.
11006	(a) Common Garter Snake, (b) Common Water Snake,	9	J. G. Detwiler, Fort Washington.
11007	(a) Common Garter Snake, (b) Grass Snake (Liopeltis vernalis),	9	W. Angus, Stoddartsville.
11017	Common Water Snake,	10	H. Horton, Harrisburg.
11018	(a) 2 Common Garter Snakes, (b) Ring-necked Snake (Diadophis punctatus), (c) 2 Blowing Vipers, (d) Black Snake (Bascanion constrictor),	10	Prof. I. L. Kinney, Portland.
11019	Grass Snake,	10	L. V. Workman, State College.
11020	Land Salamander,	10	H. W. Snyder, Pottstown.
11021	(a) 7 Purple Salamanders (Gyrinophilus porphyriticus), (b) House Snake, (c) 2 Ribbon Snakes, (d) Land Salamander,	10	J. L. Graf, Pittsburg.
11030	(a) 3 Land Salamanders, (b) Newt,	11	H. P. Hulslander, Mainesburg.
11032	2 Sculptured Turtles,	12	R. W. Wehrle, Indiana.
11038	(a) Common Garter Snake, (b) Rock Snake (Storeria Dekayi).	14	E. M. Mixer, Waterford.
11039	Sculptured Turtle,	14	A. A. Northrop, Brown Sta., N. Y.
11040	Common Water Snake,	14	G. M. Lehman, Essington.
11041	2 Queen Snakes,	14	R. W. Wehrle, Indiana.
11042	Land Salamander,	14	S. D. Keeney, Philadelphia.
11045	(c) House Snake,	15	R. W. Wehrle, Indiana.
11053	(a) Common Garter Snake, (b) Rock Snake,	17	J. J. Palmer, Greenville.
11054	Common Garter Snake,	17	R. W. Wehrle, Indiana.
11056	(a) Black Snake, (b) 4 Land Salamanders,	17	Miss A. K. Bewley, Forest Grove.
11061	(b) Common Toad,	17	J. B. Swaney, Hookstown.

SPECIMENS RECEIVED DURING OCTOBER, 1907.—Continued.

Number.	Specimen.	Date—October, 1907.	Name and Address.
11064	Common Garter Snake,	18	C. Yoder, Pleasant View.
11065	Red-bellied Snake,	18	D. K. McDermott, Karns City.
11072	House Snake,	19	G. E. Cressler, Shippensburg.
11073	Red-bellied Snake,	19	W. Lutes, Beaumont.
11074	Common Box Tortoise,	19	L. G. Schaum, Womelsdorf.
11075	3 Brown Salamanders (Desmognathus fusca),	19	Miss I. Eakman, Munhall.
11076	(a) 2 Common Garter Snakes,	19	S. S. Carpenter, Ulysses.
11086	House Snake,	22	W. G. Reedy, Newmanstown.
11091	Blowing Viper,	23	C. Knepp, Farrandsville.
11094	(a) House Snake, (b) Rock Snake,	24	Dr. H. F. Kocher, Wolberts.
11095	Leather-backed Turtle Eggs (Aspidonectes spinifer),	24	R. W. Wehrle, Indiana.
11103	Red Salamander (Spelerpes ruber),	26	Dr. J. S. Rittenhouse, Lorane.
11104	Grass Snake,	26	R. W. Wehrle, Indiana.
11113	(a) House Snake,	29	Mrs. J. W. Atkinson, Buckingham.
11114	Common Box Tortoise,	29	R. W. Wehrle, Indiana.
11115	Common Garter Snake,	29	T. H. Carpenter, Utica.
11116	Common Garter Snake,	29	S. G. Lausch, Schaefferstown.
11117	Spotted Salamander (Amblystoma punctatum),	29	A. K. Ludwig, Temple.
	Birds and Mammals.		
10913	Red Bat (Lasiurus borealis),	1	L. K. Hostetter, Landis Valley.
10938	Red Bat,	3	E. Moran, Lock Haven.
10940	Red Bat,	3	A. Barclay, Harrisburg.
10953	(a) Osprey (Pantion haliaetus),	4	A. F. Boettcher, Rolands.
10963	(a) Horned Grebe (Columbus auritus),	4	Prof. I. L. Kinney, Portland.
10970	Cat Bird (Galeocoptes carolinensis)	7	Mrs. J. W. Atkinson, Buckingham.
10974	Mole Shrew (Blarina brevicauda),	7	A. A. Davis, Clark's Green.
10975	2 Flickers,	7	R. Bedford, Starrucca.
11045	(a) Duck Hawk (Falco peregrinus) (b) Great-horned Owl (Bubo virginiinus),	15	R. W. Wehrle, Indiana.
11050	Hermit Thrush (Hylocichla aonalaschkae),	16	E. C. Atkinson, Buckingham.
11055	4 Jumping Mice (Japus hudsonius),	17	F. M. Brubaker, Johnstown.
11066	Red Bat,	18	E. Graybill, Manheim.
11076	(b) Crow (Corvus americana),	19	S. S. Carpenter, Ulysses.
11107	Common Weasel (Putorius Noveboracensis),	28	R. W. Wehrle, Indiana.
11108	Short-eared Owl (Asio accipitirinus),	28	F. Craighead, Carlisle.
11113	(b) Mole Shrew,	29	Mrs. J. W. Atkinson, Buckingham.
11125	(a) 5 Song Sparrows, (b) 3 Blue Birds,	31	C. L. Brumbaugh, Wilkinsburg.

SPECIMENS RECEIVED DURING NOVEMBER, 1907.

Number.	Specimen.	Date—Nov., 1907.	Name and Address.
	Insects.		
11130	(c) Crane flies,	4	R. P. Carr, Olyphant.
11131	Angumois Grain Moth (Tinea pelliolella),	4	J. H. Hyett, Wernersville.
11132	Noctuid larva,	4	R. V. Mitchell, Mehaffey.
11133	Rabbit Warble pupa (Oestridae),	4	W. M. Bolsinger, Ebensburg.
11140	San José Scale (Aspidiotus perniciosus),	6	A. E. Lesher, Chambersburg.
11141	Scurfy Scale (Chionaspis furfurus),	6	J. L. Ginck, New Oxford.
11142	Walking Stick (Diapheromera femorata),	6	Dr. G. Hetrick, Birdsboro.

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EXPLANATION OF PLATES.

Plate XXXIV. "Coming Home at Eventide." Houses numbered 2 and 3, from the "Story of a Martin Colony," from photographs by the author. The upper is a miniature dwelling house, with thirty-four rooms. The lower contains forty-five rooms and is patterned after the Pennsylvania State Building at the Chicago World's Fair.

Plate XXXV. Houses No. 1, 2 and 3 from "The Story of a Martin Colony," from photographs taken by the author, J. Warren Jacobs, Waynesburg, Pa. The two upper pictures were taken while the birds were collecting on the house. The central picture is from a snapshot as the birds took flight from the house. The lower pictures are from photos taken while a number of birds were resting on the houses. These show the ordinary scenes while the young are being coaxed out of their respective homes by their parents.

Plate XXXVI. (a) House No. 4, containing sixty-six nest rooms. From a photograph taken July 16, 1907 and reproduced by Mr. J. Warren Jacobs, in his second edition of "The Story of a Martin Colony."

(b) Martin Houses Nos. 3 and 4, in position, showing their surroundings. From the second edition of "The Story of a Martin Colony." From photograph taken June 15, 1907.

Plate XXXVII. Bird Boxes made and erected by the pupils of the Upsala Street School, Worcester, Mass. All the children are putting up bird houses.

From Nature Study Leaflet, "Our Common Birds. Suggestions for the Study of Their Life and Work." Biology Series No. 2, by C. F. Hodge, Ph. D., Clark University, Worcester, Mass. Plate kindly loaned by Dr. Hodge.

BIRDS AND HORTICULTURISTS.

I. Nesting Boxes and Bird Nesting.—How We May Aid the Birds in this Most Important Feature of Their Lives.--The First Step Toward Establishing Bird Colonies.

BY THE ECONOMIC ZOOLOGIST.
Illustrated by MRS. H. A. SURFACE.

As many persons wish birds to colonize around their premises this summer, this is the time to do some things to aid in drawing the birds to the desired places and keeping them there. But it must be borne in mind that there is no better prospect of wild birds living abundantly in any one region, of their own accord and under ordinary conditions, than there is of fruits springing up there spontaneously and thriving luxuriously without thought or care on the part of man. It is necessary to act intelligently to save the birds.

It is now acknowledged that birds are among the greatest friends of the grower of fruits or vegetation. From the economic standpoint, they represent a cash value far beyond previous belief. But to hope for the beneficial effects of their presence without first doing something to make them see that they are provided for and feel at home is to hope in vain.

For certain kinds of our most useful birds there is no better way to provide than to erect bird boxes or houses. The sooner this is done in the early spring the better it will be, hence it is hoped this article will be found at once timely and practical. New houses or boxes should have time to "weather" or let the newness wear off, before they are to be inspected by the feathered house-hunters. Birds have an appreciation of the appearance of stability, and do not like to appropriate to their own use structures that seem too recent or temporary. Of course any structure placed out of doors will last longer if painted, and it is well to give bird houses a good outside coating of paint, but it must have time to dry thoroughly before the time for their occupancy.

Fig. A. represents a house-shaped structure in which many kinds

of birds will nest. Yet we would advise the omission of the platform in front, as that is too convenient for English sparrows, and native birds do not care for it. It has but one door and may have as many windows (with glass well set in with putty) as the person building the house may choose. It is not necessary to make any windows in a bird house, yet one or two will prove acceptable to the birds, if kept closed so the wind can not blow through. The door, or passage opening, is the main feature of interest to the birds, and this should be made with care. In size it should conform to the size of the bird for which the house is built. For wren and chickadees, it must be an inch in diameter, for bluebirds two, and for the purple martins about two and one-half inches. This is in order that the desired occupant of the house may be able to hold it against possible intruders; for it must be borne in mind that the quarrelsome little English sparrow is constantly on the lookout for an opportunity to sink his bill into a little egg, kill birdlings in nests, and drive off birds not of his own kind. There should be but one entrance to each compartment of the house, and if this is the right size for the birds living in it, intruders will not only find themselves at a disadvantage in attempting to fight from the outside, but they will find it impossible to force an entrance through a snug port hole fairly filled with the beak and head of the defender.

Mr. H. Nehrling, in "Our Native Birds of Song and Beauty," says that after actual experiment, it was found that the English sparrow will not nest in boxes that are, like that of figure B, without a peg, floor, or supporting perch just outside the entrance (perch and peg shown in A and G, respectively), while the blue-birds fly in and out readily and seem perfectly at home in such a house, as we have proven by actual test.

It is also commonly said that the English sparrow will never nest in a box or house that swings freely, as does D.

Figure B, represents one of the neatest kinds of bird houses and one that is very acceptable to the birds; it is also quite easily made. It is nothing more than a section of a hollow log or limb with the ends boarded up and an auger hole bored for the entrance. For cheapness, neatness, rustic simplicity, ease of construction, and suitability to many birds it cannot be improved upon. We heartily commend this as one of the most simple devices that man may use as an auxiliary in his efforts to atone for past neglect of his most valuable allies.

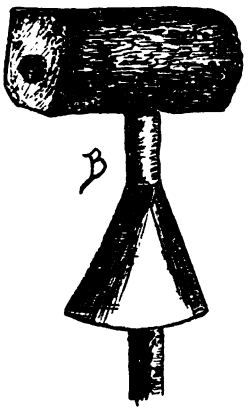
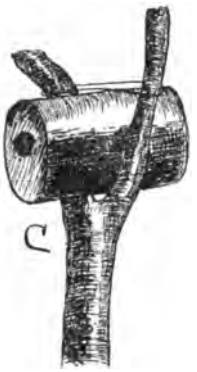


Figure B also shows a simple device to protect nests, whether on posts or in trees, from the ravages of cats, squirrels, etc. It is recognized that squirrels, especially the red squirrel or chickaree (*Sciurus hudsonicus*) are among the greatest enemies of birds' eggs, but this simple device can be used very effectively on trees or posts in parks, lawns, or other places, without injury to trees, squirrels or birds. It consists merely of an inverted funnel-shaped sheet of tin about a foot across, fastened around the post or tree which contains the nest to be protected. If it is a living tree and one does not choose to drive nails in it, the tin can be fastened effectively by merely tying securely with strong string or wire. In fact the spreading condition of the tin is not necessary, as a band of tin one and one-half or two feet in width lying close to the post or tree will prevent any animal climbing over it, as shown in figure E.

The principal birds that can be induced to nest in houses or boxes are the purple martin, bluebird, chickadee, wren, titmouse, and certain fly-catchers, besides English Sparrows. These are wholly beneficial birds (excepting the last), without one obnoxious feature. It is often said that birds, especially martins and swallows, carry lice to the premises and the vermin infest live stock or even man. However, this is absolutely untrue and unjust. Although it is true that birds are likely to be cruelly infested with very small mites, these will not live upon other kinds of animals or upon man, and we should not give credence to the stories of evil from this source. When it is observed that the birds spend a great deal of time picking and preening themselves it may be inferred that they are infested with these pests, which so sorely inflict our feathered friends only. Then it will be well to sift over the nest a little persian insect powder or buhach, which will not only alleviate the suffering of the birds, but will give them more time to act the useful part of feathered entomologists.

Another valuable feature of the presence of birds is not often considered, but is of great importance. This is their usefulness in driving off enemies of poultry, especially hawks. It would well repay every poultry keeper to have a few occupied bird houses on his premises for the sake of the practical service they may thus render. Hawks are very valuable in their place. This is not over the poultry yard, but in the woods and fields, where they may prey upon the numerous small mammals, especially the rodents, such as rats and mice,—those wholly obnoxious creatures that "have one obvious part to play, that of turning grass into flesh, in order that carnivorous Goths and Vandals may subsist also, and in their turn proclaim 'All flesh is grass.'" (Coues.)

Figure C, shows how an empty tin can may be utilized to become "some happy creature's home." The end that was cut open has been removed by heating, and in its place has been nailed a circular board with a hole cut for passage way. We have known those very interesting little birds, the house wrens, to nest in a tin can without even the closed end, and were it not for their having to protect their home against intruders, such as the English sparrow or jay, there is no reason why an open can should not always be used. For wrens the boxes or cans should be placed only high enough to be out of the way of prowling animals.

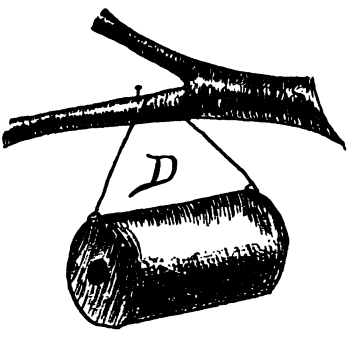


A fence corner with a clump of bushes, or the midst of an old brush pile, makes an ideal place for such birds to nest. We have had them rear two broods of young in one season in a chalk box fastened against our porch post, as shown in H.

Of course, most birds, excepting martins and sometimes bluebirds, prefer to nest in places that are slightly concealed, or at most not openly conspicuous. It would be cruel to place a tin house or can on an exposed post where the hot sun would shine down upon it, inflicting absolute torture upon the young and delicate birds as they have to stay in the nests. If the boxes cannot be placed partly in the shade of trees or buildings it would be in most cases a good plan to fasten a board above, more as a protection against the hot sun than against the rain and wind. Of course where a wooden house is used it does not need other protection.

It will also be more suitable to the birds to have their houses or boxes placed with the door to the east, so the prevailing wind and rain coming from the west will not blow in, and so they can have an opportunity to enjoy the morning sunshine at the entrance to their houses.

Figure D shows how a box, house or tin can may be supported by a wire from a pole or the branch of a tree. It is said that the English sparrow will not attempt to occupy a nesting place that thus swings free, while our native birds really appear to enjoy it; however, a recent correspondent has reported the sparrows nesting in a house thus suspended.

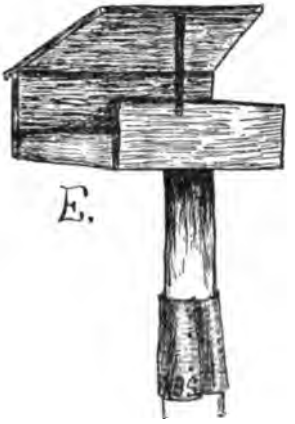


It is desirable that one end or

the roof of all bird houses and nesting boxes be detachable in order to clean them after the brood has departed, so that they will be accepted by the next family of bird tenants. For this purpose, the end of the box may be fastened with a hinge and hook. Details in these regards are not necessary, because if a person should not have enough ingenuity to construct and care for the boxes according to the needs of the birds, especially after having received a few practical suggestions, he will not have enough tact properly to take other neasures necessary in bird colonization.

Some species of birds, such as robins, that will not nest in closed houses or boxes will readily occupy some modification of the open box, shown in Figure E. This is but a box with the two ends cut away to near the bottom and a protecting board fastened to slope over one side. Among the species of birds that will nest in these open boxes are the robin, pewee, and phoebe.

Old boxes of small size, gourd shells, tin cans, or paint kegs, may be very successfully utilized for bird nesting, but new or recently used tobacco boxes or cigar boxes should never be attempted. May the hint suffice.


E.

The elevation above ground at which the house should be placed depends upon the kinds of birds for which it is intended. Martins prefer a house 25 or 30 feet above ground. while bluebirds do not care to live so high. From 10 to 15 feet above ground will suit them best. Chickadees and titmice will also nest at this elevation or lower, while the cunning little wrens prefer to keep still closer to terra firma, and will often nest in low stumps or the hollow trunks of old apple or other trees, or in boxes but a few feet above the ground.

Among the best devices that can be arranged for the home of many birds, including woodpeckers, nuthatches, wrens, chickadees, bluebirds, etc., is an old dead stump with holes in it, set upright in the ground like a post. We know of birds nesting regularly in such a place.

A very great mistake is often made by persons who write for effect rather than for the birds, and are anxious to make their structures for bird colonies attractive to the eye of man regardless of the needs of the birds. This mistake consists in grouping into one artistic (?) piece several bird boxes or nesting places, and what is worse, even advocating placing such compound affairs in shrubbery or trees. Any person qualified to write on this subject should know

that with the one exception of the martin, none of our native birds that are likely to nest in boxes or houses are gregarious, or nest in colonies, and the martins will not accept concealed nesting places where they have to fly out and in among the branches of trees. Owing to the gregarious habits of these birds a house of several compartments is proper, but it should be placed out in an open area, where the black-winged sprites can fly, and wheel, and circle and dart, and play, and catch insects with unobstructed freedom, as they, in common with the swallows and swifts, feed while flying. No American birds will consent to occupy apartment houses in partial concealment. This is left solely to the English sparrow, that vagabond that makes itself at home everywhere and is ever ready to utilize and soil anything from the top of the Statue of Liberty to the corner of a pig sty. These are not the birds we need about our premises and for the propagation of which this article is written.

Most of our native and beneficial birds prefer to have at least a small "region" of their own, in which no other birds of the same species nest. Such points should be well considered in constructing and erecting nest conveniences.

After the young are hatched they should never be fed by any person. The parent birds know just what to select and give their young, and we know of cases of innocent little birds being sacrificed through the kind but ignorant attentions of mankind. If one really cares to feed the young, the intended food should be placed near the nest where the parent birds can find it and deliver it to their young or refuse it, or eat it themselves, as they find best.

It is important to arrange for lighting and ventilating these houses. There should be holes or cracks on one side large enough to admit some light and air, but so small as to exclude other birds. These ventilating openings should not be at opposite sides, as they would thus permit currents of air to blow over and chill the young birds.

Another important consideration is to place the entrance near the top rather than at the bottom. This is because the nesting material fills the bottom of the house or box, and the birds prefer to enter at the top and hop down to their nests. Figure F shows how a hollow log may be closed at one end and fastened in a tree along a stream for the wood duck, that "vanishing game bird," and most beautiful of all American birds, which nests in such places.

Figure G is reproduced from that beautiful and interesting book, "Our Native Birds of Song and Beauty," by Henry Nehrling, of Wisconsin (Pub. Geo. Brumdee & Co., Milwaukee). It shows how a section of a dead log may be attached to a living tree in order to accommodate certain species of birds that nest in cavities.

Any kind of a box may be firmly attached to a tree, pole, or building by nails holding it to a board, which can be nailed to the post. First nail the board to the box then by nails through the lower part of the board fasten it to the post or building.

II. The Value, Destruction and Preservation of Birds.

(From the manuscript of a book on General Biology, by H. A. Surface, Professor of Zoology, The Pennsylvania State College.)

The Economic Features of Birds.

(a) Injurious. A few birds destroy poultry, but the goshawk, great horned owl, sharp-shinned hawk, and osprey, are the only species of raptorial birds that are more injurious than beneficial. Many eat fish; others eat fruits and grain, but of the birds around the farm none but the English sparrow justifies suppression. All others more than pay for their slight damage by destroying obnoxious insects, weed seeds, mice, etc.

(b) Beneficial. Birds yield to mankind eggs, feathers, down, and choice flesh food, besides guano—a valuable fertilizer. They are the chief natural factors in suppressing insects and certain weeds, and there are none that do not have some beneficial features. Also, their ethical value and the pleasures given by their songs and presence should not be forgotten. In Nature they perform an important function by scattering desirable seeds, like those of the cherry and berry bushes.

It is erroneously thought that the Bee Bird, or King-Bird, should be exterminated because it eats bees. Careful examinations of scores of stomachs have proven that it eats but few workers. It

eats many robber flies, which destroy bees, and it aids in suppressing many other kinds of obnoxious insects. It should be preserved, even in the apiary, for its economic effects. Many other species of birds deserve specific mention, but information concerning them can freely be gained from the publications of the Division of Biology, of the United States Department of Agriculture, Washington, D. C.

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The Decrease of Birds: From the second annual report of Dr. Wm. T. Hornady, Director of the Bronx (N. Y.) Zoological Park, we learn that the decrease of birds in Pennsylvania during fifteen years has been fifty-one per cent. They are decreasing rapidly, while injurious insects are seriously increasing. One reason for the increase of insects is the decrease of birds. For both their ethical and economic features our native birds should be preserved. The history of the native organisms of America will become the same as that of the European species in their country. Twenty-three kinds of birds, in the British Isles alone, have become exterminated during the past century.

Among the greatest causes of the decrease of birds are the actions of mankind, either directly in destroying them, or indirectly in failing to provide for their preservation.

Some of the steps that can be taken to induce birds to colonize about the premises are the following:

1. Do not shoot them or permit them to be stoned or frightened.
2. Erect nesting boxes. In these, ten or more species may nest.
3. Prohibit unusual noise around the premises during the nesting season, particularly while birds are selecting sites for nests.
4. Provide nesting material for use in constructing nests.
5. Put out trays of water and mud for robins, swallows, etc., to use in building.
6. Erect, and preserve old posts, stumps, and logs with holes in them.
7. Suppress prowling cats and dogs.
8. Plant a few extra fruit trees and berry bushes. Give the birds their share of fruits to pay for destroying insects.
9. Plant some of the native fruit-bearing shrubs and trees around fences. These may be service berry, raspberry, blackberry, elderberry, wild cherry, choke cherry, mulberry, haw, grape and hackberry.
10. Permit a secluded corner to grow up as a thicket for shy birds.
11. Feed and water them during times of scarcity of food and water, both in winter and in summer. Give grain in the straw to quail in winter.

12. Mark the spots where nests are built in the field and have the farming implements drawn around them without destroying them.

13. Discourage egg collecting and needless slaughter of birds.

14. Discover and check their natural enemies, which vary with locality.

15. Put a band of tin, a foot or more wide, around a tree or post containing a nest, to keep climbing enemies from eggs and young.

16. Discourage the manufacture, sale, and use of air guns, sling shots, etc.

17. Do not use for ornamentation, wearing or otherwise, the feathers or parts of birds that are killed solely for that purpose.

18. Organize societies, such as chapters of the various State Audubon Societies, for the study and preservation of the native birds.

19. Aid in disseminating knowledge of existing laws, in enforcing them, and in effecting proper new laws for the protection of birds.

20. By personal effort promote the general and specific knowledge of the value of our native birds and the necessity of protecting them.

21. Aid the growth of public opinion on this subject by advocating the observation of bird day in all schools, the introduction of bird studies, and by other means.

III. Plants For Bird Food and Protection.

One of the causes of the decrease of birds which has been so conspicuous in this State during recent years is the destruction of the trees, shrubs, bushes, and other plants that furnish them food and afford them protection. We can not expect birds to exist in numbers in a treeless country. Thoughts of birds and trees are always associated. There are certain fruit-bearing trees and shrubs which would be among the most potent factors in calling back the birds were they planted along the edges of woods and along fences and in gardens and orchards. In addition to recalling the birds they would serve the very important purpose of feeding them and thus effectively saving the cultivated fruits upon which the birds must otherwise feed to sustain themselves and their young while the little ones are yet in the nests.

It is possible to plant with a view toward a succession of fruits or seeds ripening from the time of the early ripening of fruits in the spring until fall and even to remain on trees and vines during the entire winter and feed the birds when they come again the next

spring. To guide persons who are willing to undertake this we publish below an extensive list of plants, arranged, in general, in the order of the time of ripening or the time when the fruits or seeds would be enjoyed by the birds. We have personally observed those toward the foot of the list retaining their fruits until the following spring, when the birds returning from the South feed readily upon them.

The earliest fruits to ripen are the strawberries, and it is no wonder that certain birds, like robins and catbirds, may inflict some damage to the strawberries by sticking their sharp bills into the rosy-cheeked sides of some of the early fruits in their search for the food of which they have been deprived all winter. To overcome loss in this way it is only necessary to plant some of the soft, sweet, early varieties of strawberries such as May King, Oak's Early, Red Bird, Early Hathaway, Klondyke, Senator Dunlap, Johnson's Early, Michel's Early, Haverland, Wonder or Excelsior, and let a row of these or a very few rows remain unpicked in order that the birds may have their share. They will take them with enjoyment, and when they find the dead ripe strawberries left in a few rows at the side of the berry patch, they will cease their depradations upon the varieties that man may consider more choice because larger, although not so ripe and soft.

The Amalanchier, June Berry, Service Berry, or Shade Berry, is a shrub or tree, sometimes growing as a bush, which bears fruit somewhat like the currant, varying from pink to dark bluish red. Although this is one of the earliest of the tree fruits, it has for the birds the valuable property of prolonging its season of ripening. It is much sought by all fruit-eating birds, and it would be ideal for planting for the protection of cherries and other fruits ripening during this season. This plant, as a shrub or tree, grows native along the streams and hillsides of many parts of Pennsylvania, and is called the Shadberry because its white blossoms, like clouds of snow, cover the trees during the spring, about the time the shad are running up the rivers. It is beautiful, graceful and ornamental, and should be planted for ornamental purposes as well as for the birds.

The greatest objection of the fruit-growers to certain birds is that cherries are eaten when they commence to ripen. This loss is easily overcome by planting a few more trees. Why not produce enough cherries for the owner to have an abundance to spare after the birds have had enough to pay for their summer's work of destroying insects? It is advisable to plant the early soft sweet cherries, and permit them to remain unpicked. The birds will soon learn where the real ripe, early sweet cherries are to be found, and will

leave the later and more marketable cherries untouched. The well known agricultural writer, Mr. George T. Powell, of Gent, N. Y., told us that he planted a row of Governor Wood cherries along one side of his orchard especially for the birds, and added, "I now have bird cherries by the bushel to spare and the birds are working on them, but leaving untouched my choice varieties, such as Montmorency and Richmond. These I am now selling at an extra price, because they are entirely uninjured, while my neighbors, who have not provided for the birds, are forced to sell their cherries at a discount because they are punctured." This should be an important practical lesson for every fruit grower.

The mulberry is one of the best fruits to plant for the sake of the birds. Whether it be the white or Russian, or the black or common mulberry, it matters little. In fact, both could be planted for the sake of variety and beauty. The mulberry has the important merit of ripening during a greatly prolonged season. Perhaps no fruit grown at this latitude has such a long season during which the ripe berries can be found upon the tree. This means that various fruits are protected for a long time in a place where mulberries grow and bear. While the fruit of this tree is insipid and not greatly sought by man, it is sweet and soft and especially suited to the needs of the birds. We have had berries in our own garden protected effectually from the attacks of birds nesting near them in numbers by mulberry trees growing and bearing within easy reach.

Other plants to grow for the birds, named almost in order of dates of availability of their fruit for food, are as follows: Raspberry, Blackberry, Huckleberry, Blueberry, Bayberry, Pokeberry, Elderberry, Hawthorne, Buckthorn, Viburnum, Frost Grape, Fox Grape, common wild Sour Grape, Greenbrier, Bittersweet, Euonymus or Burning Bush, Cedar, Juniper, Holly, Barberry, Gum, Spicebush, Hackberry, Mountain Ash, Five-leafed Ivy (Climbing Ivy, also called American Ivy, Woodbine and Virginia Creeper), and the English Ivy.

If we should be obliged to make a selection of only four of these, it would be as follows: (1) An early sweet Cherry; (2) the Service (June) Berry; (3) the Mulberry, and (4) the Virginia Creeper or Five-Leafed Ivy. Of course, it is not believed that any one person will wish to plant all of the trees, shrubs and vines named in the above list, but it would be well for him to plant several of them in order to be sure of a variety, and especially of a succession or series of fruits during the season. Also, it is well to plant in reference to having these fruits ripen and attract the birds at the time when it may be desired to protect some special cultivated fruit crop.

The variety to plant should then be in accordance with date of ripening in reference to that of the cultivated fruit to be protected.

Among the kinds of birds that are known to feed upon the fruits or seeds of these various plants are the following: Black-Billed Cuckoo, known to eat Mulberries; Bluebird, known to eat strawberries, Service Berry or June Berry, Blackberry, Choke Berry, Elderberry, Virginia Creeper, Dogwood, Viburnum, Bittersweet, Hackberry, Pokeberry, Cedar, Greenbrier, Juniper, Holly, Huckleberry, Bush Cranberry, Patridge Berry, Sarsaparilla, False Spikenard, Euonymus, Blackberry and Mulberry; Bluejay, eating Blackberry, Elderberry, Huckleberry, Blueberry, and Mast, consisting chiefly of Acorns and Beech Nuts; Bobolink, eating Mulberry; Brown Thrasher, eating Blackberry, Elderberry, Buckthorne; Catbird, eating Blackberry, Elderberry, Dogwood, Buckthorn, Greenbrier, Blackberry and Mulberry; Cedarbird, eating Chokeberry, Blackberry, Elderberry, Juneberry, Dogwood, Viburnum, Hackberry, Pokeberry, Cedar, Frostberry, Barberry, Huckleberry, Blackberry and Mulberry; Crow, eating Chokeberry, Blackberry, Elderberry, Virginia Creeper, Dogwood, Viburnum, Hackberry, Bayberry, Pokeberry, Barberry, Greenbrier, Juniper, Holly, Hawthorne, Blueberry and Mulberry; Flicker, eating Choke Cherry, Black Cherry, Elderberry, Juneberry, Virginia Creeper, Dogwood, Hackberry, Bayberry, Pokeberry, Frost Grape, Buckthorn and Juniper; Grackle, eating Elderberry, Juneberry, Dogwood, Strawberry, Hackberry, Blueberry, Huckleberry, and Mast, or fallen Nuts; Kingbirds, eating Chokeberry, Blackberry, Elderberry, Virginia Creeper, Dogwood, Bayberry, Pokeberry, Cedar, Barberry, Spicebush, Buckthorn, Juniper, Wild Grape, Blueberry, Raspberry, Blackberry and Mulberry; Oriole, eating Black Cherry, Juneberry, Blackberry and Mulberry; Phoebe, eating Mulberry; Red-Breasted Grosbeak, eating Mulberry; Red-Winged Blackbird, eating Mulberries; Robin, eating Choke Cherry, Black Cherry, Elderberry, Juneberry, Virginia Creeper, Dogwood, Viburnum, Mountain Ash, Strawberry, Bittersweet, Hackberry, Bayberry, Pokeberry, Frost Grape, Barberry, Spicebush, Greenbrier, Juniper, Wild Grape, Holly, Hawthorne, Blueberry, Huckleberry, Euonymus, Blackberry, Mulberry; Tanager, eating Mulberry; Downy Woodpecker, eating June Berry, Virginia Creeper, Dogwood, Bittersweet and Pokeberry; Hairy Woodpecker, eating Choke Cherry, Black Cherry, June Berry, Virginia Creeper, Dogwood, Pokeberry, Frost Grape, Spice Bush, Blackberry and Mulberry; Wood Thrush, eating Strawberry, Cedar, Juniper, Blackberry and Mulberry.

As April will be the best month in the year for transplanting all such plants, it is advisable for persons who intend acting upon these

practical suggestions for bird colonization to take steps at once toward making out and procuring their lists of plants. Many of these plants can be obtained from the native forests and thickets where they now live, and most of them are to be procured from the more extensive nurserymen of this State. The names of the nurserymen are published in our Bulletins for January and August, and it would be well to write to them soon to learn which of the desired plants they can supply.

A MARTIN COLONY.

We take pleasure in presenting to the public an article on the Purple Martin, written at our request, expressly for this Bulletin, by Mr. J. Warren Jacobs, of Waynesburg, Pa., who has had more practical experience in colonizing these birds around his premises than any other person in this State. We would call special attention to this article, as the manner of writing is straightforward, and every sentence shows that it is based upon a definite practical knowledge of the subject.

Mr. Jacobs has written a booklet giving in detail his experiences with the Martins and the results of his studies of their food and habits, and has illustrated this with photographs of the houses built in exact imitation of various interesting buildings, such as the Pennsylvania Building at the Chicago Exposition, the Pennsylvania Building at the World's Fair at St. Louis, his own home, and other structures. He has kindly loaned us for publication in this Bulletin some of the plates used in his "Story of a Martin Colony." We learn that he has recently revised and enlarged his booklet on this subject, and persons who desire can obtain it by sending him one dollar in payment for the same.

In acknowledging our indebtedness to Mr. Jacobs we should call attention to the fact that he has contributed the following article without a cent of charge, but with a view only of doing what he can in behalf of his friends, the birds. It is gratifying to find occasionally persons who are willing to co-operate with the work of the State Government in some such manner as this without feeling that he should be paid an excessive price through the mere fact that it is "for the State."

We know from observation that Martins occasionally do fly in small groups over the State, even in counties remote from anywhere they have nested in boxes, apparently seeking suitable nesting sites. We have frequently known of their nesting beneath the hoods of electric lamps, and in the borough of Mechanicsburg, Pa., we have seen them nesting on a flat board beneath the roof of an

awning over the street. At Glenn's Falls, N. Y., we saw large insects, such as Dragon Flies, that had been killed by Purple Martins and carried to their nests for their young, but dropped beneath their boxes because the insects were too large to be eaten by the young birds.

SOMETHING ABOUT THE PURPLE MARTIN (Progue subis).

Written by J. Warren Jacobs, Waynesburg, Pa.

On August 17th last I read in a Pittsburg (Pa.) daily, a dispatch from New Martinsville, West Virginia, stating that thousands of "wall martins" or "swallows" came into the town to roost on the telephone wires and so great was the weight thrown on the wires that the telephone company became alarmed lest the increasing flocks break down their wire service.

These birds were on their way to the south (West Indies, Central and South America) where they remain during our Autumn and Winter.

Suspecting the birds to be the Purple House Martin, and being desirous of settling this point and facts as to the number of the birds, I wrote my friend and former fellow townsman, Frank V. Iams, Attorney, now residing in the West Virginia city. In reply Mr. Iams corroborated the published dispatch, except that the telephone company, owning the wires, had not yet deemed it necessary to molest the birds. The birds, he said were "all House Martins, such as rest in boxes put up for their use." He further stated that the published statement that there was ten thousand of the birds, far underestimated the number, for he could sit at his own home and see more than that number; and the lines stretched out of sight of his residence.

On Sept. 7th Mr. Iams was in Waynesburg, and I had a further interesting talk with him about the gathering Martins. After replying to my letter he gave the birds further attention and found they continued to increase in numbers until, he thinks, there was nearly 25,000, if this estimate is not inadequate. After the 28th of August they began to diminish in numbers until, when he last saw them, Sept. 5, only about one-fourth remained.

The birds came into the town in large streams or "string-flocks" from all directions. Those coming down the Ohio River, and those coming up the stream, being the largest. At some parts the flocks were over a hundred feet wide. They seemed to come to the town by way of nearby valleys. Besides the large flocks already mentioned, unusually large assemblies came down the Fishing and

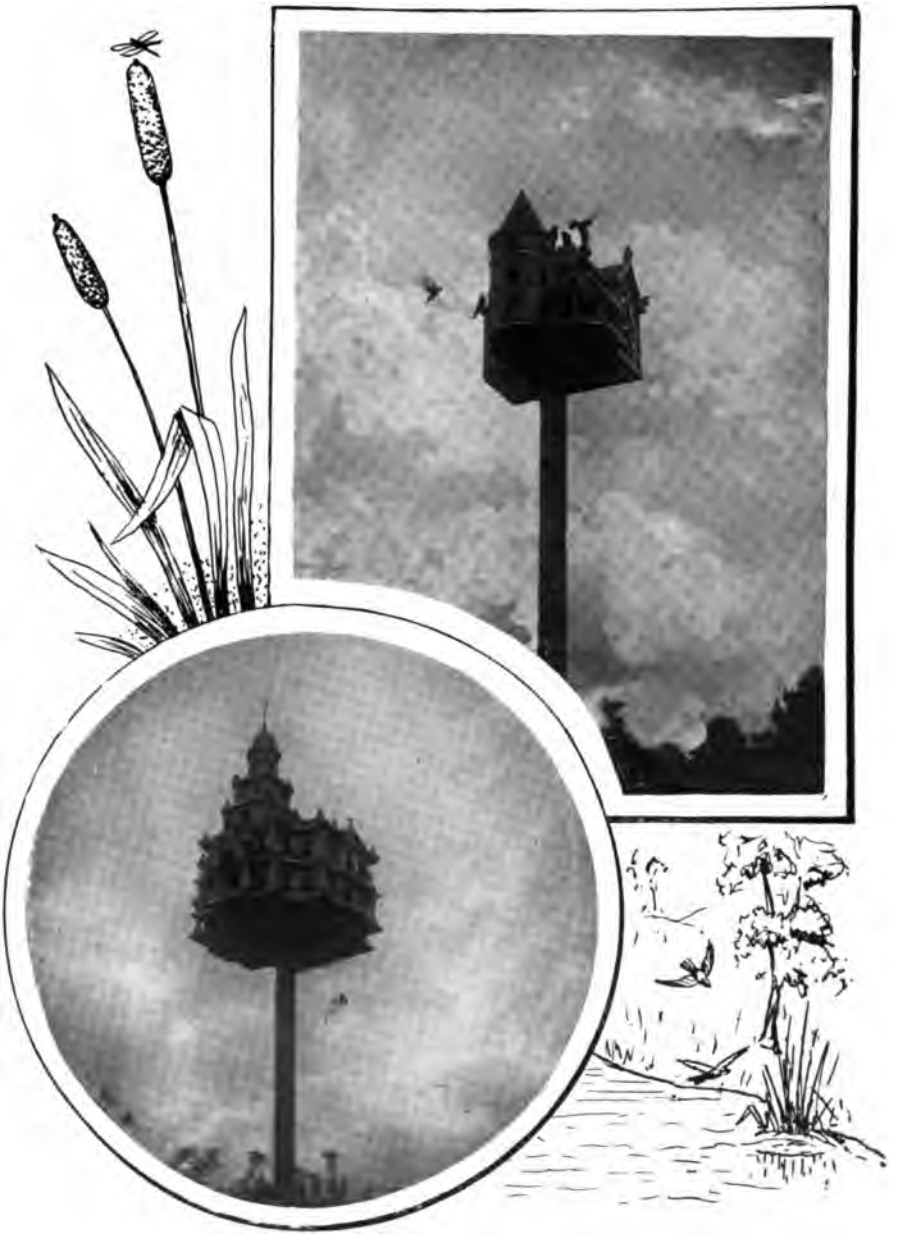


Plate XXXIV. "Coming Home at Eventide." Houses numbered 2 and 3, from the "Story of a Martin Colony," from photographs by the author. The upper is a miniature dwelling house, with thirty-four rooms. The lower contains forty-five rooms and is patterned after the Pennsylvania State Building at the Chicago World's Fair.

It would thrive along the edge of thickets and in partially open pastures, in practically the same places as the Quail preferred when it was abundant in this State. It is a beautiful bird, insectivorous and seed-eating in its feeding habits, and might become one of our important game birds. It has been successfully introduced along the western coast of the United States, and we know of its breeding undomesticated in the State of New York. We would recommend it as a bird to propagate and introduce in this State.

The reduction of the number of Quail by severe weather during the past two years has been quite perceptible. The Quail is one of our most valuable insectivorous birds, being destructive to potato beetles, grass-hoppers and other obnoxious insects. It is also an important destroyer of weed seeds. For this reason we earnestly recommend the endorsement of legislation proposed by our State Grange at its last Annual Meeting, calling for a closed season of five years for the Quail or Bob White.

Concerning the Game Laws of the State of Pennsylvania we should offer a paragraph:

The law at present provides bounties upon certain animals as follows: For each wildcat, four dollars; for each fox, two dollars; for each weasel and mink, one dollar.

We agree with the publications of the Biological Bureau of the U. S. Department of Agriculture, to the effect that bounties are not justifiable, cost too much, and do not bring the desired results. If creatures are sufficiently obnoxious to demand the efforts of mankind in exterminating them this will be done, bounty or no bounty.

All species of birds are protected by law in this State at all times excepting the Bluejay, English Sparrow, European Starling, the Kingfisher, Cooper's Hawk, Sharp-shinned Hawk, Goshawk, Duck Hawk, Pigeon Hawk, Great-horned Owl, Barred Owl, the Crow and the Raven, and the game birds which are to be shot only during their respective open seasons, and which are named by our State law as the Quail, Ruffed Grouse, Prairie Chicken, Imported Pheasant, Wild Turkey, Wild Pigeon, Dove, Reed Bird, Rail, Blackbird, Sandpiper, Tatler, Curlew or any Shorebird, Wilson Snipe (Jack Snipe), Upland or Grass Plover, Coot or Mud Hen, and Water Fowl known as Duck, Goose, Brant, Swan and Grebe. We can not see the justification in having the Dove, Blackbird, Coot or Mud Hen and Grebe upon the list of game birds, as the first-named is the only one that is edible, and the others would be shot only for useless "sport." The law provides, fortunately, for an absolutely closed period upon the Wild Pigeon until April 22, 1915. However, it is our opinion that at that date it will be found, unfortunately, that there will be none of these very interesting birds in our State.

The Audobon Society is growing stronger both in Pennsylvania and in the United States and is doing good work in bird protection and in creating and maintaining public sentiment in this regard. In the Report for Pennsylvania by the State Secretary, Miss E. W. Fisher, which was published in "Bird Lore," Volume IX, No. 6, for November and December, 1907, is the following:

" * * * The business of reorganizing the Society on this permanent basis represented most of the 'new work' done this spring, but the old activities were still kept up. Twelve circulating libraries were kept moving in the State, and a number of school children and children in societies, such as 'Bands of Mercy,' etc., have signed the Audobon Pledge and received certificates of associate membership.

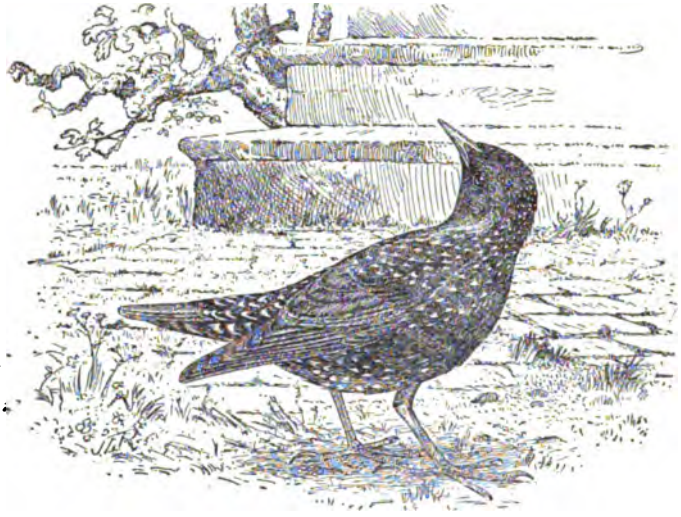
"The increase of the public sentiment for bird protection has been quite marked during the past year in this State, largely due to the good work done by the State Zoologist, and the Audobon literature distribution in schools. Indeed, it is to the intelligent work of the public school teachers who take up the subject that the Audobon Society owes some of its best results in the country districts.

"The society hopes to follow up its organization this winter with several public meetings, where illustrated talks will be given by those prominent in bird protection and ornithology (which seems still to be one of the most successful ways of reaching the general public), and by special work among the schools."

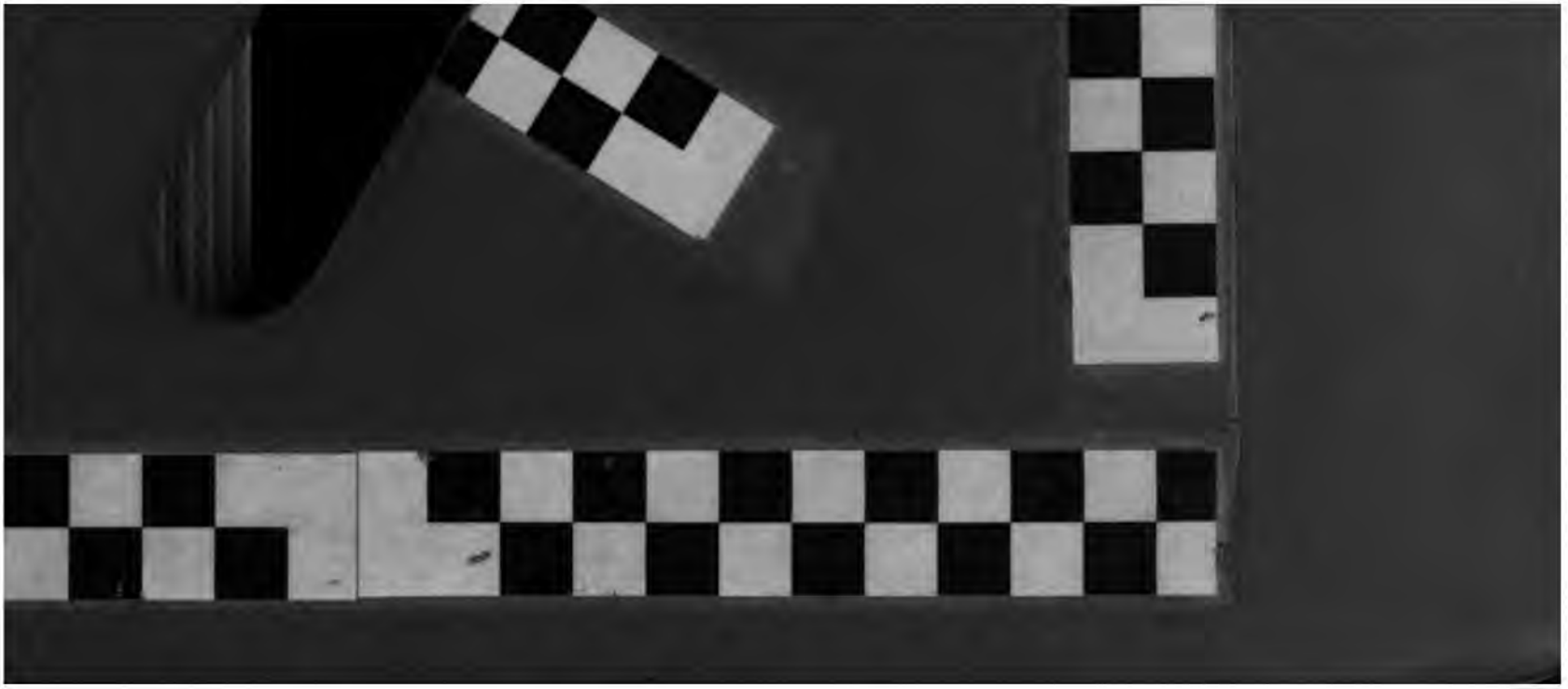
Considerable literature has come to our desk. One of the most commendable was Bulletin No. 30, by the Biological Survey, of the U. S. Department of Agriculture, entitled "Birds of California in Relation to the Fruit Industry." This consists of one hundred pages with five plates and will prove of considerable interest to bird students. We regret to be obliged to chronicle the suspension of a valued and interesting publication known as "Birds and All Nature," by the Nature Publishing Company, of Chicago, as this pictured objects in natural colors, and was commendable in its popular instruction. The Ornithologist of your Board has prepared a set of colored slides of birds and occasionally gives popular lectures on this subject, the last having been as recent as last Friday night to a church audience in Harrisburg. We recommend further activities in bird protection and intelligent legislation along this line.

Several reports have reached us concerning the increase of the English Starling and the damage done by this bird, which appears to be in its habits and haunts or place of living intermediate between the Blackbird and the English Sparrow. We regret its introduction into this country, and recommend its destruction. It appears to be a grain eater and fruit eater without much value as an insect-killer. We here show specimens of the same, with the hope

that it will be more readiliy recognized than from descriptions. These specimens were kindly loaned for this purpose by Dr. William Deutcher, of the American Museum of Natural History, who is president of the American Association of Audobon Societies. The Starling resembles a brownish blackbird with white specks or small spots on the back, but its long-drawn whistling note enables it at once to be distinguished from any blackbird found in this State.



English Starling (Sturnus vulgaris).
From Palmer, Yeag Book U. S. Dept. Agri., 1898.



THE MONTHLY BULLETIN OF THE DIVISION OF ZOOLOGY FOR MARCH, 1908.

VOLUME V, NO. 11.

Established in April, 1903, at the office of the Economic Zoologist.
Edited by H. A. Surface, Economic Zoologist, Harrisburg, Pa.

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OUR MONTHLY CHAT WITH READERS.

Possible Change of Bulletin: In order to avoid a misunderstanding and perhaps considerable explanatory correspondence we take this occasion to announce that there is a possibility of changing the Bulletin of the Division of Zoology from a Monthly to a Quarterly issue, beginning in May. This may become necessary on account of the unusual demand for field work and out-door service made upon the Zoologist in connection with the demonstration orchards which we are establishing. If this change is to be made a definite announcement will be given in the April Bulletin.

The Demonstration Orchards: We again call the attention of the public to our plans to establish demonstration orchards in many of the fruit-growing counties of Pennsylvania, to continue them throughout the year and show how to produce good fruit by controlling insects and preventing plant diseases, and to demonstrate methods of good orcharding in general. The locations of these orchards are announced in other portions of this Bulletin, and everybody interested is invited to see them. Announcements will be made by the local papers concerning the exact dates when we shall be present at the demonstration orchards.

Changing Addresses: In writing us for change of address the old as well as the new address should be given in order that we can find the names according to the system by which we have them arranged.

Writing Names Plainly: There is nothing with which a correspondent is so familiar as his own name, and nothing which he writes so frequently, so easily, and consequently so carelessly. At the same time there is nothing so important in a letter as the signature and address of the writer. Proper names are difficult to recognize, and the greatest possible care should be used to write them so plainly that there will be no mistake concerning either the address or the name of the writer. The chief cause of failure of replies to reach their proper destination is to be found in the inability to determine these accurately when written by hand.

Do You Receive Our Bulletins? We aim to publish in the Bulletins during sometime of the year something concerning practically every important plant pest in this State. It frequently happens that inquiries are made upon topics previously discussed at length in some number of Bulletins. It would save us considerable

time and correspondence if we knew the inquirer had Bulletins at hand and we could give reference by number of page, citing the exact information wanted. If the inquirer has not received Bulletins we can in most cases send a copy of the issue discussing the subject in question. It is not economical to pay postage and send duplicate Bulletins to persons who already have them. It would save for us several days per month if we knew that inquirers were receiving and preserving the Bulletins, for in attempting to answer letters in detail we could refer to pages where the desired information is given.

All communications and specimens should be addressed to H. A. Surface, Economic Zoologist, Harrisburg, Pa.

RESULTS OF SPRAYING EXPERIMENTS DURING THE SPRING OF 1907 FOR SAN JOSE SCALE.

Experiments for the control of the San José Scale were performed during the winter and early spring, before the leaves had started. Most of the experiments were performed on trees on the farm of Prof. Surface, as he gave us the privilege to test any material that we considered worth the time and expense of trying as an insecticide to control the Scale. The first requirement was to learn the proper strength to use, so there was a necessity of using the solutions very strong in some instances. This resulted, as might be expected, in the destruction of twigs or branches in some instances, and at other times it resulted in the destruction of fruit buds. It is only by such trials that we can ascertain the "danger point" of any insecticide or fungicide so that it was a great privilege that we could use a private property as an experimental farm. These facts, which are of such practical value to the farmers and fruit growers of this State, could not have been learned except by making the actual tests, regardless of the effects on the trees.

1. The Lime-Sulphur Wash: This wash was made according to the regular formula: 17 lbs. of Sulphur, 22 lbs. of Lime, and 50 gallons of water. These materials were boiled together for one hour, and applied hot, using either a York Gas Sprayer or a Niagara Gas Sprayer, at a pressure of 60 to 100 pounds to the square inch, except in a few instances which will be mentioned in due order. In fact all the experimental spraying mentioned in this report was performed with the apparatus mentioned above.

On December 5, 1906, twenty peach trees were sprayed. March 5, 1907, forty trees were treated in a similar manner. On April 16, four more trees (peach) were sprayed. These trees were in the same orchard, which we designate as orchard No. 1, and they were badly infested with San José Scale. The trees were also in a poor condition, due to lack of cultivation and trimming, and they were also badly infested with Borers. This does not mean that the present owner has neglected them, but that they were in that condition when the farm was bought this year. The trees had been neglected for several years, and due regard must be given this fact in judging of results. A second application of the Lime Sulphur Wash was given to nine trees of the group that were sprayed December 5th. This was applied on April 16th.

On this farm is another orchard of peach and apple trees, all about five years of age. They are in a healthier condition than the trees in the first orchard, as they had received more cultivation, but they were rather badly infested with Borers. This orchard is known as orchard No. 2.

Seven peach trees badly infested with Scale, 6 peach trees that were free from the pest, and 7 apple trees that were moderately infested, were sprayed on April 9. The leaf buds had burst and the leaves were ½ inch in length.

Results.—These trees were examined from time to time and the effects of the Lime-Sulphur Wash on the foliage and on the Scale were carefully noted. There appeared to be no injury to the fruit or leaf buds on any of the trees that were sprayed before the buds had begun to burst, but on those trees where the foliage had appeared at the time of spraying, it was burned rather badly yet the fruit buds were not hurt in the least.

The percentage of Scale killed did not differ perceptibly on the trees sprayed in December from those sprayed in the Spring. The percentage of Scale killed averaged 96 on peach and 94 on apple for trees sprayed only once, and 98 for peach and 96 on apple on trees sprayed twice. All the trees (peach) were free from Peach Leaf Curl, during the following summer. Peach Rot does not seem to be checked by it. This was a poor season to see the results of the different mixtures on Peach Rot as there was so much dry weather that very little Rot appeared except on trees in lower land.

2. Lime-Sulphur-Salt Wash: This material was made according to the regular formula: 17 lbs. Sulphur, 22 lbs. of Lime, 10 lbs. of Salt, and 50 gallons of water. The wash was boiled for one hour and applied the same as the Lime-Sulphur Wash.

We sprayed 18 trees on March 4, using the wash hot, and 18 trees using it cold. Of these trees, 4 that were sprayed with the

wash hot and two that were treated with the wash cold were given a second spraying on April 16th. These trees were in orchard No. 1. In orchard No. 2, eight trees that were slightly infested and six that were free from Scale were treated with this material, using it hot. These peach trees were treated on April 9th, and the leaves had already started. On the same day, we sprayed 6 apple trees that were slightly infested, 2 that were badly infested, and 9 that were free from Scale. The leaves had started on these trees and were about ½ inch long.

Results.—No injury to the trees were shown in any instance, but the foliage was injured on those trees that were sprayed after the leaves had started. Yet these trees produced a fine crop of fruit, from which fact we infer that it is better to give a tree a late spraying with such material than to allow it to go unsprayed; the best time for spraying being, of course, before the buds have burst. Leaf Curl did not appear on these trees during the summer. As these were late varieties that do not seem inclined to rot, the fact that they did not show any rot does not prove the case, but we do know from previous experiments that this material is a good fungicide and that it will prevent Rot. The percentage of Scale killed averaged 95 on trees treated once, and 96 on trees treated twice. These results were the same on both apple and peach. The results were very favorable to the growth of the trees, as they all made a fine growth and produced a large crop of peaches.

3. Sulphur-Sal-Soda-Wash : This wash was originated by us this Summer. It is made by boiling together 17 lbs. of Sulphur, 34 lbs. of Sal-Soda and 50 gallons of water. Although more expensive than the Lime-Sulphur Wash, it has the advantage of having no sediment, and of covering more trees, gallon for gallon, than any of the Sulphur washes.

On April 10th, 34 trees that were slightly infested, 16 trees that were badly infested, and 30 trees that were not infested with Scale were treated. These peach trees had the foliage about ½ inch in length.

At the same time, 3 apple trees that were slightly infested and 14 that were free from Scale were treated with this wash. All these trees were in orchard No. 2 and were in fair condition.

Results.—None of the trees were injured by this wash, but the foliage was injured, due of course to the late application of the wash. Leaf Curl did not appear on these trees. On careful examination this wash showed 98 per cent. of San José Scale killed on both peach and apple. These trees bore a good crop of fruit, free from rot.

4. Sulphur-Baking-Soda-Wash: This is also an original wash with us, and was made by boiling together 17 lbs. of Sulphur, 20 lbs. of baking soda and 50 gallons of water. It has a tendency to boil over quicker than the other Sulphur washes, which makes it rather troublesome but it produces a wash that has no sediment, and consequently does not demand strainings and does not clog the nozzles if kept clean.

On April 1st, 8 trees that were slightly infested, 5 trees that were badly infested, and 22 trees that were not infested were sprayed with this material. All were peach trees in excellent condition and the foliage had grown ½-inch in length.

Results.—Spraying the trees with this wash did not harm the foliage in the least nor did it harm any of the fruit buds, and it did kill 99 per cent. of the Scale. The trees did not show any Leaf Curl during the summer. These results show it to be a very useful wash where trees are to be treated for Scale after the leaves have appeared. The cost of materials is greater than for the other Sulphur washes though its cost is not prohibitive by any means.

5. Caustic Soda Washes: A number of washes were made by boiling Caustic Soda and Sulphur together in different proportions. Three mixtures were tried.

On March 5th, 16 trees that were moderately infested with Scale in orchard No. 1 were sprayed with a wash made by boiling together for one-half hour 4 lbs. of Caustic Soda, 17 lbs. of Sulphur, and 50 gallons of water.

This wash did not harm any of the trees nor foliage nor fruit buds, but the effect on the Scale was not such as would justify its use, as it did not kill over 80 per cent. of them.

At the same time, 19 peach trees were sprayed with a wash made by boiling 10 lbs. of Caustic Soda, 17 lbs. of Sulphur, and 50 gallons of water. This was boiled one-half hour. This wash did not give results that were entirely satisfactory, as there were some trees that had a large percentage of live Scale left on them. However none of the trees were injured in any way. The failure of this and the preceding wash is due, we think, to the inability of the small amount of caustic soda to combine with the large amount of Sulphur, in this manner making only a small amount of sodium sulphide.

On March 7th, 24 peach trees were sprayed with a wash made by boiling together 20 lbs. of Caustic Soda, 17 lbs. of Sulphur, and 50 gallons of water. This was applied hot, as were the other washes.

This wash killed all the Scale but also killed the fruit buds, although the buds had not begun to swell.

On April 9th, 21 peach trees and 12 apple trees were sprayed with the same wash. The foliage had begun to appear, and that was destroyed the same as with the other Sulphur washes; also the fruit buds were destroyed. We need not add that the Scale were annihilated.

Thus the caustic soda washes did not prove satisfactory in our experiments this Spring, though further experimenting with them may perhaps develop a wash that will not injure the tree yet will kill all the Scale insects.

DEHORNING, OR TOPPING PEACH TREES.

It may be well to mention the results of dehorning trees that have been very badly injured by Scale. When a tree is injured in that way it is necessary to do more than destroy the insects on the tree. It is necessary to cut the tree back so that what strength it may have be directed to as few limbs as possible. It will then send forth new branches and will in the majority of cases live.

Our experiments were conducted on a few peach trees that were very badly injured by Scale. Most of the trees lived. In fact all lived that had a moderate amount of vitality, and our belief is that it is better to cut a tree back rather than to have it be larger and sickly. In every instance of a dehorned tree that grew we found a tree that became very vigorous. Some of the trees that were badly injured by spraying them with caustic soda, were dehorned and they developed into vigorous trees and made a fine growth this Summer.

OUR DEMONSTRATION ORCHARDS.

As previously announced, we have arranged to establish at once a number of demonstration orchards in Pennsylvania for the purpose of illustrating the methods of properly conducting an orchard, with special reference to the control of insect pests and the prevention of plant diseases, and also incidentally showing how to plant, prune, fertilize and cultivate trees, as well as how to spray and perform such other operations as are necessary in practical orcharding. The public is invited to visit these orchards at any time and especially to come at the dates when it is announced the demonstrators will be present. These persons are to be present, regardless of weather. Announcements

will be made primarily through the local newspapers, and also through our Monthly Bulletins.* The demonstrations will be in charge of the respective local demonstrators for each district, but the Economic Zoologist, or one of his Special Assistants will be present at each of the public meetings. At these meetings not only practical work will be shown but addresses will be given, and there will be evening sessions, at many of which illustrated lectures will ge given. Persons desiring to receive aid in orcharding, and especially in the control of pests, are urged to attend, bring samples of twigs supposed to be infested, ask questions, and receive such help as can be given.

For many reasons it has been found best to select orchards in connection with public institutions. The locations of the demonstration orchards for this year, arranged according to Counties, are as follows:

County.	Orchard Of.	Post Office.	Local Inspector.	First Date.
Allegheny,	Beechmont Fruit Co.,	Oakdale,	G. W. Sloop,	Mar. 23 & 24.
Bedford,	County Home,	Bedford,	R. F. Lee,	Mar. 30 & 31.
Berks,	County Home,	Shillington,	E. C. Bowers,	Mar. 16 & 17.
Bucks,	National Farm School,	Farm School,	E. L. Loux,	Mar. 11.
Butler,	County Home,	Butler,	F. L. McClure,	Mar. 18 & 19.
Cambria,	County Home,	Ebensburg,	R. F. Lee,	Apr. 1 & 2.
Chester,	County Home,	Embreeville,	F. Windle,	Mar. 4 & 5.
Clearfield,	County Home,	Clearfield,	R. F. Lee,	Mar. 16 & 17.
Columbia,	Bloom Poor District,	Bloomsburg,	A. W. Stephens,	Mar. 6 & 7.
Cumberland,	Indian School,	Carlisle,	F. Z. Hartzell,	Mar. 20 & 21.
Dauphin,	County Home,	Harrisburg,		
Delaware,	County Home,	Lima,	M. E. Shay,	Mar. 6 & 7.
Huntingdon,	Industrial Reform School,	Huntingdon,	J. Bergy,	Mar. 26 & 27.
Indiana,	Frank H. Dougherty,	Indiana,	G. W. Sloop,	Mar. 27 & 28.
Lackawanna,	Randolph Crippen Est.,	Dalton,	A. O. Finn,	Mar. 9 & 10.
Lancaster,	Home for Friendless Children.	Lancaster,	J. D. Herr,	Mar. 2.
Lancaster,	County Home,	Lancaster,	J. D. Herr,	Mar. 3.
Lebanon,	County Home,	Lebanon,	F. R. Fertig,	Mar. 18 & 19.
Lycoming,	City Home,	Williamsport,	T. C. Foster,	Mar. 11 & 12.
Mifflin,	County Home,	Lewistown,	J. Bergy,	Mar. 24 & 25.
Montgomery,	Insane Hospital,	Norristown,	J. S. Briggs,	Mar. 9 & 10.
Montour,	Insane Hospital,	Danville,	A. W. Stephens,	Mar. 4 & 5.
Northampton,	Carter Junior Republic,	Redington,	P. R. Bolts,	Mar. 12 & 13.
Northumberland	Odd Fellows Orphanage,	Sunbury,	A. W. Stephens,	Mar. 2 & 3.
Perry,	County Home,	Loysville,	T. C. Foster,	Mar. 23 & 24.
Tioga,	Geo. T. Hatherill,	Wellsboro R. 1,	M. L. Benn,	Mar. 13 & 14.
Union,	J. N. Glover,	Vicksburg,	T. C. Foster,	
Venango,	Inst. for Feeble Minded,	Polk,	F. L. McClure,	Mar. 20 & 21.
Westmoreland,	County Home,	Greensburg,	G. W. Sloop,	Mar. 25 & 26.

For the pruning and preliminary demonstration work there will be two sections operating simultaneously. The first of these in general charge of Mr. W. E. Grove, of York Springs, is arranged as follows according to the series of dates assigned:

Mar. 2 and 3, Home for Friendless Children, Lancaster.
Mar. 4 and 5, County Home, Embreeville, Chester county.
Mar. 6 and 7, Delaware County Home, Lima.
Mar. 9 and 10, Insane Hospital, Norristown, Montgomery county.
Mar. 11, National Farm School, Farm School, Bucks county.

*It is unfortunate that the Bulletins are delayed waiting for plates to be made until it is necessary either to omit plates or issue the Bulletins late. We hope soon to find means of correcting this.

Mar. 12 and 13, Carter Junior Republic, Reddington, Northampton county.

Mar. 16 and 17, Berks County Home, Shillington.

Mar. 18 and 19, Lebanon County Home, Lebanon.

Mar. 20 and 21, Indian School, Carlisle, Cumberland county.

Mar. 23 and 24, Perry County Home, Loysville.

Mar. 24 and 25, Mifflin County Home, Lewistown.

Mar. 26 and 27, Industrial Reform School, Huntingdon.

Mar. 30 and 31, Bedford County Home, Bedford.

April 1 and 2, Cambria County Home, Ebensburg.

The second section will be in general charge of Mr. A. W. Stephens, and is arranged according to dates as follows:

Mar. 2 and 3, Orphanage, Sunbury, Northumberland county.

Mar. 4 and 5, Insane Hospital, Danville, Montour county.

Mar. 6 and 7, Bloom Poor District Home, Bloomsburg, Columbia county.

Mar. 9 and 10, Randolph Crippen Estate, Dalton, Lackawanna county.

Mar. 11 and 12, City Home Farm, Williamsport, Lycoming county.

Mar. 13 and 14, G. T. Hatherill's orchard, R. D. No. 1, Wellsboro, Tioga county.

Mar. 16 and 17, Clearfield County Home, Clearfield.

Mar. 18 and 19, Butler County Home, Butler.

Mar. 20 and 21, Institute for Feeble Minded, Polk, Venango county.

Mar. 23 and 24, Beechmont Fruit Co. Orchard, Oakdale, Allegheny Co.

Mar. 25 and 26, Westmoreland County Home, Greensburg.

Mar. 27 and 28, F. H. Daugherty's orchard, Indiana.

Some counties are not announced at this time because arrangements are not yet completed for establishing demonstration orchards in them, and others can not be undertaken this year on account of insufficiency of funds to make the work more general. Special efforts will be made next year to give particular attention to the counties that can not be reached this year.

While all the work in these orchards will be public, the afternoon and evening of the first day at each place mentioned above will especially be devoted to metings for the purpose of discussing subjects in orcharding. These meetings will be held in the orchard and in a meeting room most available and convenient for the purpose. Readers are requested to aid this work by notifying and inviting their neighbors, and by seing that all the local papers

receive notices of the coming meetings. Those meetings that are to be held before this Bulletin is mailed will be announced in time through the county papers by notices sent directly from this office.

ERRORS IN SPRAYING.

Notes from an Extemporaneous Address by H. A. Surface, Delivered at the Recent Annual Convention of the Ontario Fruit Growers' Association.

A number of erroneous impressions are common in regard to spraying. There is a general impression that spraying is a preventive of all loss in fruit growing. Nothing can be more fallacious; it is not. There are many horticultural ills that spraying can not remedy. First, there is a general feeling that it is necessary to spray to prevent the appearance of insects. I know of only one insect for which we spray to prevent its coming: That is the larva of the codling moth. We do not spray to prevent the coming of insects, although we do spray when they are present to destroy them and prevent loss by their attacks. If I had an orchard free from insects, I should not spray with anything, so far as insects are concerned, until the pests appear, excepting that I would spray at the proper time and with the proper material for the codling moth.

There is a very general impression that Bordeaux mixture is an insecticide; it is not. At the same time, it may act as a repellant and drive away certain insects. It is simply a fungicide, composed of copper sulphate and lime, and if we wish to make an insecticide of it, we must add an arsenical poison.

There is also an impression that Bordeaux mixture will cure plant diseases. There is a difference between curing and preventing. Prevention is better than remedy. It will not cure fungus diseases, but will help prevent their appearance. There is a great difference between spraying with insecticides and with fungicides; the difference is this: With insecticides, in all cases save that of the codling moth, we spray, when the pests are present, as a remedy; with fungicides, we spray to prevent the appearance of a disease, such as scab, leaf spot, rot, mildew, peach leaf curl, etc. After such a disease as leaf spot or fungus has started in a leaf it can not be cured in that leaf, or after the rot disease appears in a fruit it can not be cured in that particular fruit.

Again, there is an impression in our State that benefits can come from spraying trees in bloom. We should not spray blossoms, and no benefit of any kind is to be had from doing so. It is bad horticultural practice. If there be a surplus of blossoms and you wish to reduce them it will help to thin the crop, but it is a poor way of thinning, and not to be recommended. I have seen abortive fruit produced in this way, and besides, there is the danger of killing bees, which do so much to fertilize and cross fertilize the blossoms.

There used to be an idea that spraying would poison fruit and vegetables. This especially was thought to be the case in spraying cabbage for the cabbage worm. Our best gardners spray cabbage with Paris Green, and analyses show that a person would have to eat about two hundred cabbage heads to get enough Paris Green to affect him. Spraying does not poison fruit and there is no danger of its doing so.

Another mistake is the thought that animals are liable to be poisoned by eating the grass under trees sprayed with Paris Green or Arsenate of Lead. There is almost no danger in this respect. Of course there should be no grass in the orchard, unless the "sod-mulch" system is being practiced—a method that is well worth trying.

There is an idea that spraying kills bees. With lime-sulphur wash that is absolutely wrong as the wash is applied before the buds burst. With other insecticides there is no danger as long as they are not applied while the blossoms are open.

A writer for "Cyclopedia of Agriculture," recently wrote an otherwise excellent article on birds in relation to Agriculture, in which he made the remarkable statement that birds are liable to be killed by modern methods of spraying. I consider this an error. Spraying does not kill birds, and I wrote the Editor saying that if the statement were published, I should protest it and that others would protest it too. I am glad to learn that it was stricken out of the proof.

Many people think that if a little is good, more is better. That is a very poor belief. There is more danger from too much than there is from too little. Too much many endanger or kill the plant. Too diluted a formulae may result in not accomplishing the work for which you are spraying—in not preventing the disease or killing the insect—but you will have no other loss than that of time and material and possibly the effects of continued pests; whereas, if you use too much you are liable to injure the fruit or even kill the trees. There are certain materials of which it makes little difference if you use too much, such as the lime-sulphur mixture and the Bordeaux mixture, applied when not in leaf,

The question has been raised as to whether aphids could be killed by the lime-sulphur wash. I know it can be done, as I have seen the boiled lime-sulphur wash clean up both the Apple aphis and the Cherry aphis, applied just before and when the buds were bursting.

It is the general opinion of too many spray pump operators that materials can be mixed by guess. They should be weighed and measured most carefully, to the very ounce. When I tell a man to spray eight per cent. kerosene I do not mean ten per cent., and if he should use four per cent. or five per cent. above what I say he is to use, it is liable to result in injury to his trees, under certain conditions. A man should know the exact percentage to use, as well as the correct time to apply it.

There is a general impression that spraying can be done when the wind is blowing and satisfactory results obtained. It is almost impossible to spray against the wind. You should spray with the wind, and cover that side of the tree; then you must wait till the wind has ceased or changed direction before spraying the other side. That is the only proper way to spray if windy. You can not throw a spray against the wind, although you might use a squirt-gun or a fire-hose and throw a stream or jet, but that is not spraying. The spraying material, in a fine state of division, should drift over the trees in the form of a mist, and not be thrown as a stream, and sometimes (when trees are in leaf) not under too great pressure. I have known of cases where so much pressure was used with Bordeaux mixture that the material was actually driven into the stomata or pores of the leaves, which were severely injured in consequence. There is a possibility of injury by using too much power when the leaves are in a delicate or tender condition.

Question—Would 35 pounds pressure be about right?

Answer—Yes, and then you will not have this difficulty. Many people using power outfits spray at 60 to 80 or more pounds pressure, and rarely get below 40 pounds. High pressure will not cause injury when trees are dormant.

Many suppose that the height to which the spray is thrown depends solely upon the power of the apparatus. That is not so. What is required more than anything else for spraying very high trees is a sufficient length of hose and an extension rod, with ladders for operators to climb.

Efficient spraying cannot be done with poor, cheap, hand apparatus. For the average orchard I would not recommend anything cheaper than a good barrel sprayer, with at least twenty-five feet of hose and an eight-foot extension rod.

Many men seem to think that one spraying should be enough. Some write me, "I sprayed my trees once and the scale is still there; I am disgusted with the formula you recommend." It takes more than one dose of medicine to cure a disease, and more than one spraying to overcome scale.

If we can control the San José Scale, and produce first-class fruits without much expense, that ought to be sufficient to satisfy us for the present, we can never get rid of it entirely, but may eradicate it from some individual orchards. Do not think you can spray two or three infested trees in an orchard and leave the rest. Under such conditions all the trees should be sprayed, being sure of the second or re-touching spraying.

Some think they can modify the formula recommended and get better results. It is not safe to attempt it.

The following facts are not generally known:

That sprayed fruit keeps longer than unsprayed, without storage or special treatment.

That sprayed fruit stays on the trees much longer than when unsprayed.

That some diseases are not to be prevented by spraying, namely, apple and pear blight and peach yellows.

That pruning invigorates a tree and is one of the essential steps in combatting its pests.

The operation should be for a definite object; we should know for what we are spraying, then spray thoroughly with the right material in the right proportions, with the proper apparatus, at the right time. This is a very important thing. Spraying is not in itself sufficient to produce good fruit; we must have cultivation, pruning and thinning of fruit, and finally we must spray as the most satisfactory means of controlling insect pests and preventing plant diseases.

Question—Do we understand you to say that spraying will not prevent leaf curl?

Answer—It will prevent, but not cure it after it has started; after the leaf has started to curl, it will not cure it. There is a difference between prevention and cure.

Question—How soon after the leaves are off is it safe to spray for Scale in the fall?

Answer—At least ten days should elapse after the leaves are off. The base of the petiole of the leaf leaves a deep surface scar, and until this heals over it is not advisable to spray. (This refers to fall spraying for scale insects.)

In spraying for codling moth, the important point is to spray just after the petals fall, and then again after (10) ten days time.

Some of our growers are getting 98 per cent. perfect fruit. You may use Paris Green and Bordeaux mixture together, although I believe Arsenate of Lead is more effective and nearly as cheap as Paris Green, but a good unadulterated Paris Green is excellent. Use a third of a pound of Paris Green or two pounds of Arsenate of Lead in fifty gallons of the Bordeaux mixture.

Question—What do you use for Oyster Shell Bark louse?

Answer—I have seen bad infestations entirely cleaned up by one double spraying of lime-sulphur wash, in the fall of the year. This mixture will kill all the scales, and also the cigar case bearer, eggs of the tent caterpillar, Aphids, and many other insects.

Question—What do you mean by double spraying?

Answer—Two coats: the second applied just after the first coat is dry; for Scale always give the trees this re-touching spray. This is especially necessary in spraying for San José Scale.

Our best growers are spraying once every year (in the early Spring), because the Lime-Sulphur wash has such a tonic effect on the trees, although it may not be absolutely necessary in order to keep the scale in check.

Question—Do you recommend scraping?

Answer—I do not think it necessary as far as scale is concerned

Question—Does it injure the tree?

Answer—It can, if too deep. You should not scrape so deeply as to injure the inner bark.

Question—Is salt of any value in the mixture?

Answer—It is not necessary, and we do not now recommend it. When salt is added to this mixture there sometimes may be injury to peach twigs and buds by spraying just after the leaves fall.

We are in the midst of experiments with Sulphur-Soda Wash, as a treatment for San José Scale. Our first experiment killed the fruit buds, and we have not experimented far enough for me to say at just what strength it should be used with safety. My opinion is that it should be about as follows:

Four lbs. caustic soda or concentrated lye, or even washing soda, boiled with three times as much sulphur, for half-and-hour, and diluted with forty or fifty gallons of water. Those who try it it should do so only experimentally and on a small scale.

SPRAYING BREVITIES.

1. The best time for spraying for San José Scale, green lice or aphids, peach leaf curl and some other pests is in the early

spring just as the buds are swelling and just before the leaves appear, although good results can be obtained by spraying with proper material at any time when the tree is dormant. The best material for use in the control of the San José Scale is the Lime-sulphur wash boiled one hour, either made at home or purchased ready made of some such firm as the Niagara Spray Company, of Middleport, N. Y. The commercial is as efficient as the home-made material and cheaper than any other commercial insecticide, and has the advantage of also being a fungicide. The homemade Lime-sulphur wash is made by boiling sulphur, seventeen pounds, with Calcium Lime, twenty-two pounds in anything but copper, for one hour, with enough water to keep it boiling, and afterward dilute with water to make fifty gallons. Sulphur can be purchased from such firms as the following:

The General Chemical Co., 608 Bourse Building, Philadelphia.

Powers-Weightman-Rosengarten Co., Philadelphia.

The Thomsen Chemical Co., Baltimore, Md.

2. The chief preparation for spraying should be a careful pruning of the orchard and equipment with ladders, hose and a metal strainer. The operator should be protected by the use of cheap leather gloves dropped into melted tallow, and vaseline rubbed on the exposed parts of the skin. It is advisable to wear goggles or protecting glasses over the eyes and also protecting cloth around the neck.

3. Apparatus. The apparatus must be adapted to the number and size of the trees. In general a barrel outfit, with an air chamber that will give a strong even pressure and work smoothly and easily will serve the purpose in all but a most extensive orchard. Use at least twenty-five feet of good strong hose, an extension rod and eighth-turn and a cluster of two or three nozzles on the eighth-turn.

4. Always use Calcium Lime. This does not become dark green when boiled but remains the color of cooked tomatoes. It is stronger than the Magnesium or milder Lime.

5. To keep Lime fresh buy as much as may be wanted and keep it in vessels under water in the form of paste. Use three times as much of the Lime as the dry in any formula.

6. Use long hose. The successful spraying of tall trees does not depend so much on the use of powerful apparatus as upon hose, extension rods and ladders to get the nozzles to the tops of the trees.

7. Always use an extension rod. This may be from six to eight feet long. It can be made of ordinary gas pipe, with the joint and connection at the middle to take it apart for carrying if desired.

8. Have a "Y" attachment on the extension rod provided for carrying either two or three nozzles. Of the oldstyle "Vermorel" nozzle at least three should be used, but of the "Mistry" nozzle two at a time are sufficient.

9. By all means use on the end of the extension rod a small bent attachment called "eighth-turn." Turn the nozzles slightly to one side, or use a metal extension rod with the farther end bent slightly to one side.

10. For economy the extension rod can be made of ordinary gas pipe and if desired jointed at the middle, so it can be taken apart for convenience in carrying.

11. Always give the second or retouching spraying at any time after the first coating becomes dry enough to permit the operator to see what spots have been missed.

12. When the wind is blowing spray from one side or with the wind only, giving both the first and second coats from this side if desired, and when it changes or ceases, spray the other side thoroughly.

13. To spray high trees is not so much a question of pump power, as of sufficient hose, extension rod and ladders or elevation to get the nozzles to the tops of the trees.

14. Be sure all bark is well covered from the tips of the highest branches to the base of the tree.

15. Before spraying prune out all wood that is dead or dying and all that is superfluous and makes the top one-sided or too bushy.

16. After spraying prune off all twigs and branches that could not be reached and well covered.

17. Protect the hands and faces by proper covering, and the horses by the use of blankets.

18. Always strain all substances containing Lime or other sediment by pouring it through a conical strainer, such as was described and illustrated in our October Bulletin, or through wire cloth having about twenty-eight or thirty meshes to the inch.

19. Commercial Insecticides are not as economical as the home-made, and often not as effective nor as safe, but the commercial Lime-sulphur Liquid can be found as reliable as the home-boiled material.

20. Be careful about using oils, either home-made or commercial, as when used strong enough to kill the scale they are liable to injure the trees as we have personally observed and as have many recent reports indicated.

21. If an oil spray should be used skim off all oil that does not dissolve in the water in the spray tank.

22. Do not experiment extensively and do not use much new material at one time. Try it first on a few trees.

23. The San José Scale is not "dying out," except by the faithful and intelligent use of the spray pump or by killing the trees that it infests.

24. Painting will not take the place of spraying, and no material applied to the trunk can be taken into the sap of the tree or injure any pest.

REPORT OF THE ENTOMOLOGIST OF THE STATE BOARD OF AGRICULTURE.

Mr. Chairman, Officers and Members of the State Board of Agriculture:

To me falls the duty of rendering to you a report of the entomological conditions in Pennsylvania during the year 1907. I have no way of knowing how much of my correspondence and service regarding insects is due to my position with this Respected Board, but I know that in the capacity of Economic Zoologist of this Commonwealth our chief correspondence, publications and practical work has been along this line. We have, therefore, been in position to watch closely the outbreaks of injurious insects, the remedies that have been used successfully or otherwise in their repression, the enemies of insects and the appearance of literature upon this subject as well as the undoubtedly increased attention given it by the public.

We rejoice to say that with our other insect troubles, we have not been invaded with such destructive pests as the West Indian Peach Scale, the Brown Scale, the Gypsy Moth and the Brown Tail Moth. While we recognize the serious effects of the San José Scale and the great havoc it has played in this State we are certain that the conditions would be much worse were any one or more of the above named pests to be established within this Commonwealth. Therefore, it is important that we watch for them and guard carefully against their introduction, and should they become established it is necessary to take all possible means of stamping them out at once.

The worst pest, of course, attacking vegetation in this State is the San José Scale, which has been responsible for the destruction of millions of dollars' worth of fruit trees, and which is causing

an annual loss of hundreds of thousands of dollars' worth of property in the State and reducing our fruit and fruit prospects. In many of the large fruit-growing districts two or three years ago nearly all the horticulturists were discouraged with it and ready to quit, but we are pleased to be able to report that now they have taken new courage and are producing almost perfect fruit in spite of the presence of the San José Scale. They are learning to keep such pests in check by the most simple, cheap and efficient remedies.

Where there is a great demand there will eventually appear a great supply. This State has experienced a very urgent demand for an effective and convenient insecticide. As a consequence, materials of many kinds have been placed upon the market. While we can not discuss here in detail the various remedies for the San José Scale, it appears important for us to say that it has been demonstrated beyond doubt that the best and cheapest remedy for this pest is the Lime-sulphur Wash:

17 pounds Lime, 22 pounds Sulphur, Water to boil an hour, boil, strain and add water to make 50 gallons, and spray by giving two good coats over all the bark.

Fortunately, two or three companies are now making commercial preparations of the Lime-sulphur Compound, which are effective and which although costing a little more than the home-made Lime-sulphur Wash are not nearly as expensive as the commercial oil preparations now on the market, and this has the additional advantage over the oils of beings a fungicide as well as an insecticide. It is our pleasure to report that the material made and sold as "Ska-Kill," at Waynesboro, Pa., has been withdrawn from manufacture and sale. It has proven entirely inefficient and unsatisfactory, as we indicated it would, and demonstrated it by actual test. We hope to see all commercial materials that fail to give satisfactory results properly exposed, in order that purchasers may act intelligently in attempting to suppress pests with such insecticides. For this reason, we deem it necessary to call attention to one of the so-called soluble oil preparations sold under the name of "Target Brand," made at Martinsburg, W. Va., which is reported to us from different sources as having resulted in the destruction of trees to which it was applied. It is important for our practical fruit growers to know that such unfortunate results have been obtained by their brother horticulturists and are liable to recur at any time and place.

Attention should be called to the experiments which have been conducted by the Division of Zoology of the State Department of Agriculture and of which publication has been made in the

Monthly Bulletin of said Division. Practically all insect pests in this State have been therein discussed and formulæ for suppressing the same have been published in the May, June and July numbers. These may be obtained free by writing for them. Also the various Experiment Stations and the U. S. Department of Agriculture have published extensively upon entomological topics, and persons interested may obtain literature without charge upon almost any topic he may desire.

Upon the insects concerning which we have had considerable correspondence in this State during the last year are the following:

Ants on lawns, in houses, in cornfields, attending aphids or plant lice, on fruit trees, and otherwise. We have shown that ants in lawns can be destroyed by making holes in the ground reaching to the bottom of their nests and into each hole pouring a half teaspoonful of Carbon Bisulfid. From houses they are best exterminated by tracing the path or line they follow to their nests and pouring benzine or gasoline into the nest to destroy the queen. Ants in cornfields, in the spring, have proven annoying, not by their direct injury, but by taking care of the plant lice which infest the roots of corn plants and prove quite obnoxious. To overcome this it is best to plow the ground in the fall, and cultivate it as late as possible until it freezes, and in the early spring cultivate again with a spring-toothed harrow, then harrow it later and plant the corn late after having kept down the weeds and grass of early spring. Many persons see the ants on trees or shrubs and ask for a remedy. It is not the ants that should be remedied, but the plant lice, which are attracting these little insects. Many ants are seen going up and down trees, and it may almost always be taken that it is because either plant lice or scale insects are present on the branches or leaves of the trees, and by the sweet secretions called honey dew, they are furnishing food to the ants. Contact insecticides ridding the trees of suctorial pests will soon result in the disappearance of the ants.

Aphids and plant lice have been the subject of a great deal of correspondence. They are especially liable to appear upon the leaves of trees during the early summer and cause these leaves to become deformed or twisted out of shape. Within the leaf and upon the branches beneath them, as well as upon the ground, are often found glistening or shiny drops and rather black sooty spots. These shiny drops looking like honey are called honey dew, and the dark spots are the results of a fungus developing in the honey dew. The best remedy for plant lice is to spray with contact insecticides, such as one pound of whale oil soap dissolved in six gallons of water, applied just as the buds are bursting, or

the Lime-sulphur solution applied as for San José Scale, applying it after the buds swell and just when the first of them commence. to burst and show green. We have sprayed trees with the green leaves quite apparent and the pink of the blossoms commencing to show, and have killed the scale insects and plant lice without injury to the leaves or fruit. The Lime-sulphur regularly recommended was used for this.

The apple aphis passes the winter in the form of eggs on the branches of the trees, and is thus easily reached by a good contact insecticide. I have also had very positive reports of the cherry aphis, sometimes called the brown plant lice, having been destroyed by the spring application of the Lime-sulphur Wash for San José Scale.

In some portions of this State the Green Louse or Plant Louse on the potato has been so abundant as to have proven destructive, but it can be held in check by spraying with Whale Oil Soap Solution or strong Decoction of Tobacco or eight per cent. Kerosene Emulsion.

The Gray Maple Aphis has caused a great deal of alarm by its appearance on the under sides of Norway maple shade trees along streets, and causing the leaves to fall abundantly about midsummer. While this was unusually abundant during the past year, we do not generally consider it such that it is necessary to take practical steps for its control, but if such should be thought necessary, it should be sufficient to spray thoroughly with a mild contact insecticide.

The Wooly Aphis is a very serious orchard pest. This little bluish-white Plant Louse is to be found in most orchards where the bark has been slightly injured. It attacks the branches, the trunk or the roots. By looking around the edge of the injured spot a bluish-white ring may be often seen. Upon examination this is found to consist of these little pests, sometimes looking as though covered with flour. It is best to treat them either by spraying or by washing the injury with a brush dipped into a mixture of pure White Lead and Linseed Oil or a very strong solution of Soap or Soft Soap. Where this occurs upon the roots of trees, it is advisable to bury an abundance of Tobacco Dust around the roots. This not only acts as a very good orchard fertilizer, being worth about at least twenty dollars per ton for this purpose, but also acts as a valuable insecticide in destroying such pests as Wooly Aphis and other root-infesting insects.

Bagworms have attracted considerable attention by their unusual numbers and destruction of foliage, but as these are so easily seen while the trees are dormant, and so easily killed, both by

hand picking at that time, and by spraying with Arsenical Poisons after the leaves appear, there is no reason why injury should be experienced by this pest.

Household pests, such as Cockroaches, Bedbugs, Flies, Fleas and other insects, have been the subject of much inquiry, and have been controlled satisfactorily, and in fact in many houses were entirely exterminated by thoroughly and properly fumigating with Hydrocyanic Acid Gas. There is no reason why one should suffer from such pests after having been informed of the efficiency and ease with which they can be exterminated.

The subject of bees and Bee-keeping has received considerable attention from the members of the State Bee-Keepers' Association and others, and several persons have tried Bees of the various races. It is generally accepted that the Italian is the standard race of bees known to American bee-keepers at present.

Among Beetles, the Asparagus Beetle has been extending its range over the State, but as this is easy to keep in check by dusting with freshly slaked lime, or with flour and Paris Green, one part of the poison to forty parts of Flour, there is no reason why it should be very destructive. The Striped Cucumber Beetle was abundant and injurious in most parts of this State, but is prevented chiefly by covering the plants with netting until the vines start to run.

The unquestionably good effects of Lady Beetles as destroyers of obnoxious insects, and especially of young Scale Insects and Plant Lice, are noted many times. Also the value of the Ground Beetles as predaceous insects in destroying larvæ and other insects.

Bark Beetles have continued to bore their little round holes through the bark of trees that are declining and hasten their death, giving the appearance of having been in many cases the sole cause of the trouble. It is to be remembered that wherever a branch is dying through having become broken or otherwise, the Bark Beetle is ready to attack it, and oftentimes we see the work of the Shot-Hole Borer, and as this is in a tree that is already dead or dying, we think it is more destructive than the facts warrant. If trees are so declining as to be attacked by the Shot-Hole Borers, they should be cut and burned, and thus prevent the spread of the pests to other trees.

Borers of fruit trees have been unusually active, but the fruit growers have had another year to test the efficiency of pure Linseed Oil and White Lead used as paint, applied during the early part of the summer to prevent such pests as well as later ravages by Rats and Mice. We have seen thousands of apple trees so painted and no injury has come. In fact we have tried it on our

own peach trees, and although this was done last summer, we can not yet report injury, yet we still call attention to the fact that the Peach-tree Borer is an insect that works lower in the ground, and is not to be prevented by this method. Therefore it is scarcely necessary to paint any but apple, pear and quince in order to prevent the attacks of Borers. The Peach Twig Borer has occurred in this State as a comparatively new pest. It is to be destroyed by the regular formula for spraying with the Lime-sulphur Wash for the San José Scale and at the same time of year as recommended for this pest.

The Borer in potato plants and many other forms of vegetation has proven quite destructive and has attracted considerable attention. Since this lives chiefly in large weeds or rushes, like bull weeds and artichokes, it is very important to destroy these larger weeds by mowing them two or three times during the summer. This pest can then be kept in check by thorough cultivation of plants and by burning as soon as they appear to wilt from the effects of its infestation.

The Cabbage Root Maggot has been unusually severe and has destroyed much of the early planted cabbage as well as turnips and radishes. Our experiments have proven that it is best to prevent this by putting a band or disk of tarred paper around the plant at the time it is set. These can be cut very rapidly with a punch somewhat like a wad cutter for gun wads. They should be nearly ten inches in diameter and slit in the centre to let them be passed around the plant. If plants be not thus protected and later be infested with the Rootworm, this pest can be killed by treating with Carbolic Emulsion as discussed in the Monthly Bulletin of the Economic Zoologist for March, 1907. Fortunately, the late cabbage is not infested with this pest as much as is the early planted, and therefore, it is recommended to plant late that which is needed for the winter supply and for making sourkraut and the chief family use of the year.

The Green Worm or Larvæ of the White Butterfly has not been known to be so destructive during the past year for the reason that the more extensive gardeners and truckers have now learned to control it by simply spraying with Arsenate of Lead or Paris Green applied at any time when the pests are present and before the heads are three-fourths grown. Also dusting with Flour and Paris Green while the leaves are damp with dew will prove effective. Use one part of Paris Green to forty parts of Flour. We know where poisons have been used on cabbage for this pest for years without evil results.

Cabbage Plant Lice have proven quite destructive and should

be killed by spraying with Whale Oil Soap, one pound in six gallons of water, or similar insecticides as recommended for Aphids.

The Curculio has been as abundant as ever on peash, plum, cherry and quince, but is being held in check by many orchardists by spraying with Arsenate of Lead in Bordeaux Mixture and combining this with jarring of the trees in the morning to catch the pests.

A few correspondents reported Cutworms in abundance, but this was only on sod ground, and where the ground was plowed in the fall and the insects exposed by late fall and early spring cultivation, they were not found so destructive. Also their experiments in using poisoned bran for these pests were very successful, as was published in one of our Bulletins for last spring.

The European Fruit Scale, Forbes' Scale and Putman's Scale are species of the genus Aspidiotus, thus belonging to the same genus as the San José Scale and closely resembling the last-named pest. They have been found very extensively by our inspectors and it is not infrequent that an error is made by confusing these with San José Scale. They are not so destructive and need not cause undue alarm.

Flea Beetles have been present and especially destructive on potatoes by gnawing holes in the epidermis and making the leaves appear to be specked with brown. However, they are repelled or destroyed by spraying with Bordeaux Mixture with an Arsenical poison added.

The grain pest known as the Angoumois Grain Moth has continued its destructiveness, especially in the Southeastern portion of this State. However, we have had some excellent reports of loss prevented by this pest by threshing the grain early and getting it into the bin rather than leaving it in the straw. One person in particular reported to us that he had threshed about one-half of his crop shortly after harvest and the other half was left until the early part of the winter. The former was not injured by the Grain Moth, while the latter was practically destroyed. This is in accordance with our recommendations.

Grasshoppers have been observed by us as serious enemies of fruit by gnawing peaches through the skin at the upper side as they are ripening, especially during the very dry part of the year which, of course, is the growing side, and resulting in decided blemishes. We have also had reports of their destroying tobacco and eating the leaves and fruit of melons. We recommend poisoning them with the Criddle Mixture or spraying with sweetened arsenical poison. The Criddle Mixture is discussed in the Bulletin of the Division of Zoology for last May.

The Hessian Fly has not been so destructive as during some

years, but as usual the wheat planted early has been generally infested more or less.

Lady Beetles as beneficial insects have been reported from a great many different sources. Leaf Hoppers on rose, apple and potatoes have been injurious in some places, but have been destroyed by two or three applications of contact insecticides, such as are recommended for Plant Lice. Maggots or the larvæ of the Flies in raspberry canes have appeared in some parts of this State, thus causing a wilting down of the tips during the summer. They should be cut and burned when found infested. The Mediterranean Flour Moth has been destructive in mills and graneries in the Eastern parts of this State, and it has also spread to the extreme Northern or Western portions of the State, but has been cleaned up satisfactorily by two fumigations at intervals of about one week with Hydrocyanic Acid Gas. In some of the larger mills this operation has cost over fifty dollars for the fumigation, but has given very satisfactory results in destroying all insects in the building as well as Mice and Rats by the bushel.

Mites, especially the Red Mites, have been reported injuring many varieties of trees, shrubs, ornamental plants and shrubbery, and have been controlled by spraying with the Lime-sulphur Wash, the same as for the San José Scale, or with contact insecticides containing Sulphur or Sulphur Compounds.

Slugs on cherry and pear trees have been very abundant and destructive, but easily killed by dusting with freshly-slaked Lime with about one-fortieth part of Paris Green added.

Spraying is becoming far more extensive than ever before and our citizens are producing better fruits, planting young orchards and having better results and a more hopeful outlook than has previously been known in this State.

SPECIMENS RECEIVED DURING SEPTEMBER, 1907.

For each entry of which the species is determined a common specific or general name is given, followed by the scientific name. Following entries are given with the common name when that is specific, and with the scientific name when the common name is not specific name, allowing the contributor to follow the list back for the general name.

Number.	Specimens.	Date—September, 1907.	Name and Address.
	Insects.		
10609	18 species of insects,	3	K. Geist, Covington, La.
10611	Regal Moth larva (Citheronia regalis),	3	W. C. Wilson, Cochranville.
10612	Long-horned Grasshoppers,	3	Miss R. Cook, Harrisburg.
10613	Milkweed Butterfly Chrysalis (Danais plexippus),	3	B. M. Stone, Stull.
10614	Moth larvæ,	3	Miss G. Beebe, Odin.
10618	(a) Io Moth larva (Hyperchiria io), (b) Sphinx larva (Pholus pandorus),	3	S. M. Beecher, New Milford.
10619	7 species of insects,	3	S. Baldy, Catawissa.
10620	Chestnut Weevils (Balaninus sp.),	3	L. L. Springer, Edenville.
10621	4 species of insects,	3	Miss M. Gifford, Newton Hamilton
10624	(a) San José Scale (Aspidiotus perniciosus), (b) Scurfy Scale (Chionaspis furfurus),	3	Mrs. M. C. Sparks, Rainsburg.
10625	Flesh Fly,	3	R. J. Peschko, Camden, N. J.
10627	Magnolia Scale (Neolecanium cornuparvum),	4	C. S. Fouse, Mt. Union.
10628	Io Moth larvæ,	4	G. H. Huston, Ford City.
10629	Regalis Moth larva,	4	W. B. Henneberger, Greencastle.
10630	Regal Larva,	4	C. E. Fitch, Kemblesville.
10636	Meal Worm (Tenebrio molitor),	4	G. F. Brown, Grassflat.
10637	Cecropia larva (Samia cecropia),	4	J. Rauch, Harrisburg.
10638	Yellow Swallow-tail Butterfly (Papilio turnus) Black Form,	4	H. B. Jackson, Harrisburg.
10644	White Fly (Aleyrodes sp.),	5	————, Kennet Square.
10646	Scurfy Scale,	5	W. H. Price, Analomink.
10647	Sawfly larvæ,	5	V. O. Switzer, Danville.
10648	Long-horn Beetle (Orthosoma brunneum),	5	D. P. Carrier, Corry.
10649	Tomato Worm (Phlegethontius 5-maculata),	5	L. Dunkle, Robesonia.
10650	4 species of Beetles,	5	W. J. Mills, Atlanta, Ga.
10656	Ichneumon Wasps,	6	D. A. Claar, Queen.
10657	Cecropia larva,	6	Miss M. Hartzell, Lebanon.
10658	Regal Moth larva,	6	E. E. Borry, Stevens.
10660	Parasitic Digger Wasp (Discolia sp.),	6	W. H. Stout, Pine Grove.
10661	Cecropia Moths,	6	J. W. Minsker, Harrisburg.
10662	15-spotted Lady Beetle (Anatis ocellata),	6	Dr. Stewart, Independence.
10663	Warble from Cat,	6	Miss K. Bishop, Carlisle.
10664	(a) Saddle-back Caterpillar (Sibine stimulea), (b) Arctiid Moth,	6	G. and J. Landis, McCulloughs Mills.
10665	Regal Moth larva,	6	H. K. Walton, Christiana.
10666	Regal Moth larva,	6	D. K. Heckendorn, New Bloomfield.
10669	Yellow Swallow-tail Butterfly Larvæ,	7	A. O. Apker, Penfield.
10670	Hag Moth larva (Phobetron pithecium),	7	L. L. Springer, Edenville.
10673	(b) American Giant Water Bug (Belostoma americanum), (c) Eyed Elater (Alaus oculatus), (d) Long-horned Grasshopper,	9	W. H. Bullock, Honesdale.
10677	Oyster-shell Scale (Lepidosaphes ulmi),	9	Miss E. W. Collins, Swarthmore.
10679	Imperial Moth larva (Eacles imperialis),	9	G. A. Davies, Lansford.
10680	White Fly,	9	W. M. Robinson, Danville.
10682	Plant Lice,	9	A. W. Crownover, Greensburg.

SPECIMENS RECEIVED DURING SEPTEMBER, 1907—Continued.

Number.	Specimens.	Date—September, 1907.	Name and Address.
10683	Mole Cricket (Gryllotalpa sp.), ...	9	A. C. Peters, Montgomery.
10685	Regalis Moth larva, ...	9	J. L. Bowman, Camp Hill.
10687	(a) Rose Scale (Aulacaspis rosæ), (c) Work of Cucumber Beetles (Diabrotica sp.), ...	9	O. Sloat, Manchester.
10691	Regal Moth Larva, ...	9	Mrs. Montgomery, Penbrook.
10696	White-spotted Skipper, larva and cocoon (Eudamus tityrus), ...	10	Mrs. W. B. Mehaffie, Duncannon.
10697	Regal Moth larva, ...	10	A. Burgess, Glenmore.
10699	7 species of insects, ...	10	R. I. Myers, Welty.
10700	(a) Bagworm Cocoons (Thyridopteryx ephemeraeformis), ... (b) Tussock Moth larvæ (Hemerocampa leucostigma), ...	10	W. H. Stout, Pine Grove.
10701	Cicada, ...	10	J. C. Colegrove, Gaines.
10702	Flannel Moth larvæ (Lagoa crispata), ...	10	S. P. Garber, Kerrsville.
10703	Mole Cricket, ...	10	W. O. Woodring, Chicora.
10704	Jumping Plant Lice (Psyllidæ), ..	10	T. W. Way, West Chester.
10705	Squash Bug (Anasa tristis), ...	10	C. H. Groff, Berwyn.
10706	Plant Lice, ...	10	Miss R. Mackall, Beaver.
10707	Work of Ants, ...	10	Dr. I. M. Wells, Harrisburg.
10709	5 species of insects, ...	11	E. W. Walp, Pen Argyl
10712	Fly Larvæ, ...	11	W. M. Sharrer, Cherry Tree.
10713	(a) Luna Moth larva (Actias luna), ... (b) Prominent Moth larva (Datana integerrima), ...	11	G. W. Brown, Sabula.
10714	Pholus pandorus larva, ...	11	M. G. Hill, Rush.
10715	Leopard Moth larva (Ecpantheria deflorata), ...	11	A. R. Miller, Barnesville.
10716	Tomato Sphinx Larva with microgaster parasites, ...	11	W. O. Bishop, Harrisburg.
10717	Imperial Moth larva, ...	11	J. M. Drum, Mercersburg.
10722	San José Scale, ...	12	H. Maurer, New Berlin.
10723	Oyster-shell Scale, ...	12	D. P. Gerberich, Lebanon.
10724	Regal Moth larva, ...	12	J. M. Crull, Landisburg.
10725	(a) San José Scale, ... (b) Scurfy Scale, ...	12	F. G. Wolfe, Bangor.
10727	Dogday Cicada (Cicada tibicen), ..	12	Mrs. S. A. Craig, Brookville.
10729	Parasitic Wasps (Thalessa lunator), ...	12	A. E. Westbrook, Knoxville.
10730	Crane Fly (Tipula abdominalis), ..	12	G. R. Styer, Berwick.
10741	Milkweed Butterfly, ...	13	J. Raver, Harrisburg.
10742	(a) Yellow-necked Datana (Datana ministra), ... (b) Red-humped Apple Worm (Schizura concinna), ...	13	J. W. Wagner, New Florence.
10744	(a) Cecropia larva, ... (b) Celery Worms (Papilio polyxenes), ...	13	W. Jones, Old Forge.
10745	5 species of insects, ...	13	H. H. Stevens, Enid.
10746	(a) Regal Moth larva, ... (b) Cecropia larvæ, ... (c) Luna Moth larvæ, ...	13	D. K. Heckendorn, New Bloomfield
10747	Under-wing Moth, Catocala sp., ..	13	C. Anderson, Harrisburg.
10750	(a) Dragon Flies, ... (b) Cicada, ...	14	R. C. Beaver, Greenville.
10752	(a) Bagworm Cocoon, ... (b) Tipula abdominalis, ...	14	Miss F. E. Wagner, Mechanicsburg.
10757	Short-horned Grasshopper (Schistocerca americana), ...	16	Miss M. Edwards, Harrisburg.
10758	Bagworms, ...	16	A. Reichenbach, Collegeville.
10760	Cicada, ...	16	E. J. Baird, Lock Haven.
10761	Chestnut Weevils, ...	16	L. L. Springer, Edenville.
10762	(a) Nerve-veined Insects (Neuroptera), ... (c) White-flies, ...	16	G. W. Mayberry, Holmesburg.
10763	Parasitic wasp (Thalessa atrata),..	16	Miss A. H. Tompkins, Pittston.
10769	Sphinx Larva (Sphinx chersis), ...	17	F. Koenig, Harrisburg.
10770	Imperial Moth larva, ...	17	B. Converse, Granville Summit.
10771	Walking Stick (D. femorata), ...	17	J. E. Senft, Hanover.
10773	Cecropia Larva, ...	17	M. Halderbaum, New Paris.
10775	Fall Webworms (Hyphantria cunea), ...	17	E. R. Bruyate, Shippensburg.

SPECIMENS RECEIVED DURING SEPTEMBER, 1907—Continued.

Number.	Specimens.	Date—September, 1907.	Name and Address.
10776	(a) Oak Worm (Anisota senatoria), (b) Regal Moth larva, (c) Io larva,	17	H. A. Brightbill, Jr., Marsh Run.
10777	(a) Cecropia Moth, (b) Imperial Moth, (c) Giant Water Bug (Benacus griseus),	17	I. F. Mansfield, Beaver.
10778	Oyster-shell Scale,	17	J. W. Grimes, Claysville.
10779	Plant Lice,	17	O. T. Rentschler, Philadelphia.
10780	(a) Cicada, (b) Ground Beetle,	17	Miss H. Anthony, West Chester.
10782	Syrphid Flies,	17	J. Q. Keener, VanVoorhis, W. Va.
10783	Crane Fly larvæ,	17	H. M. Homan, Vogansville.
10784	Saddle-back larva,	17	G. C. Jack, Harrisburg.
10790	Prominent Moth larva (Melalopha inclusa),	18	W. H. Smith, Schuyler.
10792	Imperial Moth larva,	18	S. M. Robinson, McConnellsburg.
10793	Milkweed Butterfly Chrysalis,	18	H. C. Reinhold, East Petersburg.
10794	Io Moth larva,	18	P. Hanson, Erie.
10795	(a) Scurfy Scale,	18	E. F. Phillips, Tower City.
10796	Thalessa atrata, (b) Mole Cricket,	18	P. K. Moore, Trent.
10799	(a) San José Scale, (b) Scurfy Scale,	18	S. G. Sarver, Newport.
10800	Mole Cricket,	18	W. H. Paxson, Lahaska.
10801	(a) Plant Lice, (b) 2-spotted Lady Beetle (Adalia bipunctata),	18	E. E. Wells, Wilkes-Barre.
10802	9 species of insects,	19	S. Baldy, Catawissa.
10804	(a) Oyster-shell Scale, (b) San José Scale,	19	W. L. Stevenson, McVeytown.
10805	Katydid (Cryptophyllus perspicillatus),	19	L. S. Foulk, Schuyler.
10806	(a) Io larva, (b) Tussock Moth larva,	19	J. W. Fryling, Sunbury.
10807	Regal Moth larva,	19	W. D. Morton, Concordville.
10808	Plant Lice,	19	W. Motter, Altoona.
10810	Cicada,	19	Miss L. Pritchard, Harrisburg.
10812	Regal Moth larva,	19	J. S. Shuman, State Line.
10813	Tomato Sphinx,	19	N. Lambert, Harrisburg.
10814	San José Scale,	19	E. R. Klinedinst, Mechanicsburg.
10818	(a) Io Moth larva, (b) Regal Moth larva, (c) Cicada,	20	Dr. J. B. Kalbfus, Harrisburg.
10819	Tussock Moth larva,	20	H. Simpson, Edgerly.
10820	Tomato Sphinx,	20	L. A. Boyce, Drumore.
10821	(a) Plant Lice, (b) Lady Beetle (Hippodamia convergens),	20	W. H. Hoerner, Saginaw.
10822	Katydid (Amblycorypha oblongifolia),	20	G. N. Peifer, Sinking Springs.
10823	Saddle-back Caterpillar,	20	M. E. Davis, Norristown.
10824	Cecropia Cocoon,	20	J. E. Dickey, Olivedale.
10830	(a) Larva of Midges (Chironomidæ), (c) Lepidoptera eggs, (d) Lepidoptera larvæ, (d) Caddis Fly cases, (e) Microlepidoptera and cocoons,	21	H. K. West, Danville.
10833		23	G. B. Sims, Cherry Tree.
10835	7 species of insects,	23	Prof. I. L. Kinney, Portland.
10836	Milkweed Butterfly Chrysalis,	23	Miss L. A. Hickok, Bedford.
10837	Cicada,	23	J. B. Zigner, Harrisburg.
10838	4 species of insects,	23	Miss F. E. Wagner, Mechanicsburg.
10839	Io Moth larva,	23	A. B. Miller, Barnesville.
10840	Cicada,	23	W. A. Warner, Stickney.
10841	(a) Plant Lice, (b) Arctiid Moth larva, (c) Bagworm cocoon,	23	G. W. Mayberry, Holmesburg.
10842	10 species of insects,	23	A. H. Stevens, Enid.
10845	Hag Moth,	24	R. E. Beuchoff, Lemasters.
10846	Ecpantheria deflorata,	24	J. H. Zeigler, Redhill.
10847	Blister Beetle (Meloe americanus),	24	F. W. Peiffer, Fishers Ferry.

SPECIMENS RECEIVED DURING SEPTEMBER, 1907—Continued.

Number.	Specimens.	Date—September, 1907.	Name and Address.
10848	Hag Moth,	24	W. H. Ramsey, Coraopolis.
10849	Pholus pandorus larva,	24	D. N. Kern, Allentown.
10850	(a) Pigeon tremex (Tremex columba),	24	L. B. Gilmore, Saegertown.
	(b) Stink Bugs,		
	(c) Plant Bugs (Capsidæ),		
10851	(a) Polyphemus larva,	24	Miss J. E. West, Danville.
	(b) Arctiid larva,		
	(c) Moth larva,		
10852	False Maple Scale (Phenacoccus acericola),	24	I. F. Mansfield, Beaver.
10853	Mole Cricket,	24	J. Caldwell, Chambersburg.
10854	Silver Fish (Lepisma sp.),	24	Miss A. M. Fretz, Sellersville.
10855	(a) San José Scale,	24	J. H. Hollingworth, Wallingford.
	(b) Leaf Hoppers (Jassidæ),		
10856	(a) Drone Fly (Eristalis tenax),	24	A. B. Miller, Barnesville.
	(b) Butterfly (Argynnis sp.),		
10857	(b) Psocids,	24	Mrs. M. M. Powers, Harrisburg.
10858	(c) Short-horned Grasshopper,	25	L. A. Gibson and W. O. Woodring, Chicora.
	(d) Roach,		
	(e) Long-horn Beetle (Prionus laticollis),		
10860	(a) Yellow Swallow-tail Butterfly larva,	25	A. B. Myrick, Leolyn.
	(b) Cicada,		
10861	Plant Lice,	25	J. Middendorf, Wyalusing.
10863	Luna Moth larva,	25	A. B. Miller, Barnesville.
10864	Cecropia Moth larva,	25	F. Glaser, Harrisburg.
10865	Tomato Sphinx Pupa,	25	J. E. Dezler, Tulpehocken.
10872	Imperial Moth larva,	26	L. M. Dunkle, Robesonia.
10873	(a) Sphinx pupa,	26	F. A. Degler, Cheat Bridge, W. Va.
	(b) Moth pupa		
	(c) Butterfly Chrysalis,		
10874	5 species of insects,	26	Mrs. J. W. Atkinson, Buckingham.
10876	Regal Moth larva,	26	A. S. McGinity, Marion Centre.
10877	Cecropia larva,	26	E. J. Baird, Lock Haven.
10878	Cicada,	26	C. Mosclein, Harrisburg.
10886	Cecropia larva,	27	E. J. Nicholas, Mt. Bethel.
10887	Bagworm cocoons,	27	J. A. Reeser, West Leesport.
10888	Locust Borer (Cyllene robiniae),	27	B. S. Bowdish, New York.
10889	Cicada,	27	Miss K. E. Lehman, Coudersport.
10890	Red-humped Apple Worm,	27	C. T. Harbaugh, Sewickley.
10895	Saddle-back Caterpillar,	28	Miss E. M. Strite, Greencastle.
10896	Celery Worm,	28	R. H. Wolf, Sunbury.
10900	Regal Moth larva,	30	F. Decker, Saluvia.
10901	(a) Red-humped Apple Worm,	30	C. F. Hayes, Curwensville.
	(b) Yellow Swallow-tail Butterfly		
10902	Saddle-back larva,	30	H. R. Miller, Robesonia.
10903	Cecrophia larva,	30	J. C. Colegrove, Gaines.
10904	(a) Moth pupæ,	30	A. C. Spangler, Selinsgrove.
	(b) Spotted Grape Leaf Chafer,		
10905	Papilio troilus,	30	E. P. Miller, Altoona.
	Invertebrates not Insects.		
10609	(q) Spider,	3	K. Geist, Covington, La.
10616	Spider,	3	M. L. Sheetz, Stoverdale.
10659	Centipede,	6	M. L. Goss, Altoona.
10681	Slug,	9	E. S. Black, Little Silver, N. J.
10725	(c) Mites,	12	F. G. Wolf, Bangor.
10728	Lycosid Spider,	12	H. C. Aaron, Kingsville.
10743	Hair Worm (Gordius sp.),	13	E. H. Alberty, Dyberry.
10745	(b) Hair Worm,	13	A. H. Stevens, Enid.
	(g) Lycosid Spider,		
10759	Mites,	16	F. M. Bream, Gettysburg.
10762	(b) Mites,	16	G. W. Mayberry, Holmesburg, Phila.
10798	Mites,	18	E. W. Heberly, Utahville.
10817	Bass Worms,	20	W. J. Sheldon, Springboro.
10835	Crayfish,	23	Prof. I. L. Kinney, Portland.
10857	(a) Centipede,	24	Mrs. M. M. Powers, Harrisburg.
10858	(f) Millipede,	25	L. A. Gibson and W. O. Woodring, Chicora.
10859	(a) Centipedes,	26	L. A. Gibson, Chicora.
	(b) Millipedes,		

SPECIMENS RECEIVED DURING SEPTEMBER, 1907—Continued.

Number.	Specimens.	Date—September, 1907.	Name and Address.
	Reptiles and Batrachians.		
10605	Ring-necked Snake (Diadophis punctatus),	3	J. F. Reisinger, Ickesburg.
10606	Common Water Snake (Natrix sipedon),	3	F. A. Shaw, Wellsboro.
10607	Ring-necked Snake,	3	D. H. Bauman, Mance.
10608	(a) 3 Mud Turtles (Kinosternon pennsylvanicum), (b) Bull Frog (Rana cates beana), (c) 3-Toed Box Tortoise (Terrapene triunguis),	3	K. Geist, Covington, La.
10610	Granite Salamander (Plethodon glutinosus),	3	E. S. Seaman, Wilmore.
10623	Common Garter Snake (Thamnophis sirtalis),	3	E. H. Welk, Kleinfeltersville.
10635	Common Water Snake,	4	J. F. Reisinger, Ickesburg.
10641	Blacksnake (Bascanion constrictor),	5	F. G. Couch, Andersonburg.
10642	Sculptured Turtle (Clemmys insculptus)	5	A. F. Seaman, Wilmore.
10643	Red-bellied Snake (Storeria occipitomaculata),	5	Mrs. R. S. Hampton, Titusville.
10653	Blacksnake,	5	T. A. Berkey, Easton.
10654	Eggs of Blowing Viper (Heterodon platirhinos),	6	K. Geist, Covington, La.
10667	Box Tortoise (Terrapene carolina),	6	J. Lawrence, Coatesville.
10672	Copperhead Snake (Agkistrodon contortrix),	9	H. M. Raal, Dallastown.
10673	(a) 2 Purple Salamanders (Gyrinophilus porphyriticus),	9	W. H. Bullock, Honesdale.
10674	(a) 3 Soft-shelled Turtles (Aspidonectes spinifer), (b) Common Box Tortoise,	9	R. W. Wehrle, Indiana.
10675	3 Common Garter Snakes,	9	A. W. Smith, Blairsville.
10676	2 Common Garter Snakes,	9	A. W. Smith, Blairsville.
10684	2 Rock Snakes (Storeria dekayi),	9	R. Rogers, Karns City.
10693	Varied Treetoad (Hyla versicolor),	10	G. J. Wimmer, Nazareth.
10694	4 Opaque Salamanders (Amblystoma opacum),	10	I. R. Berry, Coatesville.
10708	Common Water Snake,	11	R. Sebring, Farrandsville.
10709	(a) Common Water Snake, (b) Spotted Salamander (Amblystoma punctatum), (c) 2 Newts (Diemictylus viridescens),	11	E. W. Walp, Pen Argyl.
10710	Pilot Snake (Callopeltis obsoletus),	11	A. W. Smith, Blairsville.
10720	2 Painted Turtles (Chrysemys picta),	12	S. Baldy, Catawissa.
10721	Common Garter Snake,	12	Prof. I. L. Kinney, Portland.
10726	Purple Salamander,	12	C. E. Dietterich, West Pike.
10731	Common Water Snake,	13	J. V. Kline, Huntingdon.
10734	2 Purple Salamanders,	13	J. A. Mitchell, Punxsutawney.
10735	(a) 20 Brown Salamanders (Desmognathus fusca), (b) 4 Land Salamanders (Plethodon cinereus), (c) Red Salamander (Spelerpes ruber), (d) 2-lined Salamander (Spelerpes bilineatus), (e) 3 Immature Salamanders,	13	Miss H. D. King, Bryn Mawr.
10736	Common Water Snake,	13	C. Barber, Apollo.
10737	Brown Salamander,	13	S. D. Kinney, Yardley.
10739	Opaque Salamander,	13	H. A. Brightbill, Marsh Run.
10748	Pilot Snake,	14	J. R. Derr, Sunbury.
10749	Brown Salamander,	14	G. L. Taylor, Wellsboro.
10754	Red-bellied Snake,	16	W. O. G. West, Danville.
10755	(a) 16 Brown Salamanders, (b) 2-lined Salamanders, (c) 8 Land Salamanders (d) Newt,	16	R. J. Simm, Jefferson, O.

SPECIMENS RECEIVED DURING SEPTEMBER, 1907—Continued.

Number.	Specimens.	Date—September, 1907.	Name and Address.
10756	(a) Purple Salamander, ...	16	I. Swartwood, Falls.
	(b) 2 Granite Salamanders, ...		
10767	Common Garter Snake, ...	17	J. Vallerchamp, Halifax.
10781	Common Box Tortoise and egg, ...	17	J. H. Zeigler, Redhill.
10785	Common Box Tortoise, ...	18	J. H. Wingert, Lewisburg.
10786	Grass Snake (Liopeltis vernalis),..	18	W. M. Sharrer, Cherry Tree.
10787	House Snake (Lampropeltis d. triangulus), ...	18	S. E. Pfeiffer, Harrisburg.
10788	Pilot Snake, ...	18	Prof. W. Y. Welch, Clarion.
10789	Hellbender (Cryptobranchus alleganiensis), ...	18	E. Parathemore, Harrisburg.
10815	3 Speckled Turtles (Clemmys guttatus), ...	19	W. H. Grim, Hamburg.
10816	(a) Common Box Tortoise, ...	20	R. W. Wehrle, Indiana.
	(b) Sculptured Turtle, ...		
10825	Snake skin, ...	20	Miss M. MacKenzie, Philadelphia.
10827	Eggs of Blacksnake, ...	20	I. C. Elder, Chambersburg.
10829	Common Garter Snake, ...	21	E. E. Johnson, Lost Creek.
10830	(a) Granite Salamander, ...	21	H. K. West, Danville.
10831	(a) 4 Brown Salamanders, ...	21	Miss G. A. Beebe, Odin.
	(b) 1 Purple Salamander, ...		
10833	(a) Granite Salamander, ...	23	G. B. Simms, Cherry Tree,
	(b) Newt, ...		
	(c) Brown Salamander, ...		
10835	(a) Hoptoads (Bufo l. americanus), ...	23	Prof. I. L. Kinney, Portland.
	(b) Green Frog (Rana clamitans)		
	(c) 2 Meadow Frogs (Rana palustrus), ...		
	(d) Painted Turtle, ...		
	(e) 2 Common Garter Snakes, ...		
	(f) 3 Land Salamanders, ...		
	(g) 3 Brown Salamanders, ...		
10842	Hoptoad, ...	24	E. P. Hipple, Mechanicsburg.
10844	(a) Newt, ...	24	L. V. Workman, State College.
	(b) Brown Salamanders, ...		
10881	7 Common Garter Snakes, ...	27	H. Schaeffer, Harrisburg.
10882	House Snake, ...	27	F. G. Couch, Andersonburg.
10883	2 Common Water Snakes, ...	27	J. H. Clough, Montrose.
10884	Common Water Snake, ...	27	J. A. Shupp, Gilbert.
10892	2 Ground Snakes (Carphophiops amoenus), ...	28	Mrs. C. Mellott, Sipes Mills.
10897	Red Salamander, ...	30	B. W. Bohn, Robesonia.
10898	Blacksnake, ...	30	H. H. McGinnis, Parkers Landing.
10899	Blacksnake, ...	30	W. D. Dixon, St. Thomas.
	Birds and Mammals.		
10883	Common Weasel (Putorius noveboracensis), ...	4	J. A. Jefferson, Easton.
10888	Brown Bat (Vespertilio fuscus), ..	6	T. McNew, Harrisburg.
10892	Red Bat (Lasiurus borealis), ...	10	R. Silverthorn, North Springfield.
10732	Ruby-throated Hummingbird (Trochilus colubris).	13	Dr. J. L. R. Heichbold, Clearfield.
10733	Short-tailed Shrew (Blarina brevicauda), ...	13	A. B. Miller, Barnesville.
10738	Red-shouldered Hawk (Buteo lineatus), ...	13	Frank Green, Jr., Graceton.
10753	Raccoon (Procyon lotor), ...	14	G. H. Williams, Blossburg.
10766	Sharp-shinned Hawk (Accipiter velox), ...	17	W. F. Shafer, Cogan Sta.
10834	Sharp-shinned Hawk, ...	23	Prof. I. L. Kinney, Portland.
10862	Carolina Rail (Porzana carolina),..	25	R. W. Wehrle, Indiana.
10893	Rose-breasted Grosbeak (Hedymeles ludoviciana), ...	28	W. W. Climenson, Honeybrook.
10894	Horned Grebe (Columbus auritus).	28	F. W. Lehman, Coudersport.

SPECIMENS RECEIVED DURING JANUARY, 1908.

Number.	Specimens.	Date—January, 1908.	Name and Address.
	Insects.		
11241	Hemisphaerical Scale (Saissetia hemisphaerica),	3	E. F. Sherman, Glen Lyon.
11243	Beetle larvæ,	3	A. D. Morganthall, Waynesboro.
11244	Greenhouse Scale (Chrysomphalus aonidum),	3	F. N. Floyd, Dillsburg.
11247	Common Lady Beetle (Megilla maculata),	8	I. S. Hartzler, Belleville.
11248	San José Scale (Aspidiotus perniciosus),	8	R. Archer, Picture Rocks.
11250	Scurfy Scale (Chionaspis furfurus),	11	————, Dreshertown.
11251	San José Scale,	11	N. H. Long, Greensburg.
11253	Scale insects (Diaspis caruell),	13	W. H. Wolff, West Chester.
11254	2-spotted Lady Beetle,	14	J. A. Clarke, Berwyn.
11255	Scale insects (Eulecanium cerasifex),	15	W. C. Shepherd, Altoona.
11258	Oyster-shell Scale (Lepidosaphes ulmi),	20	W. Norris, Conshohocken.
11260	Katydid eggs,	20	J. H. Maurer, Manayunk.
11261	(a) Oyster-shell Scale,	20	D. J. Houck, Laanna.
11262	Oyster-shell Scale,	27	I. P. Pardee, Hazleton.
11264	San José Scale,	27	J. H. Zeigler, Red Hill.
11266	(a) Blister Beetle (Epicauta pennsylvanica), (b) Scurfy Scale,	27	F. R. Knecht, Nazareth.
11267	Life History Mount of Telea polyphemus moth,	27	C. W. Selden, Chicago, Ill.
11272	Eggs of Katydid,	30	A. C. Powell, Philadelphia.
11274	(a) Hemisphaerical Scale, (b) Greenhouse Scale (Hemichionaspis aspisdistræ), (c) White Flies (Aleurodes sp.),	30	————, Cheltenham.
11275	Collection of inflated Lepidoptera larvæ,	30	R. Dickson, Pittsburg.
	Invertebrates not Insects.		
11245	Nematode,	8	Miss P. F. Waterman, Centreville.
11252	Nematod,	11	C. M. Sneisire, Pittsburg.
11261	(b) Mites,	20	J. D. Hauck, Laanna.
	Reptiles and Batrachians.		
11259	Common Water Snake (Natrix sipedon),	29	R. W. Wehrle, Indiana.
11269	Brown Salamander (Desmognathus fusca),	28	E. S. Mattern, Allentown.
11270	Copperhead Snake (Agkistrodon contortrix),	28	Prof. S. C. Smucker, Downingtown.

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OUR MONTHLY CHAT WITH READERS.

This Bulletin. It may not seem proper for one to call attention to the results of his own efforts, but we can not refrain from saying to the citizens of Pennsylvania, that we consider this present issue, the best and most useful Bulletin of the sixty that have been published and issued from this office during the past five years. We have needed in this State some popular literature containing brief and accurate descriptions of insects and the work they perform, giving the common names of the insects in such a way that they may be recognized and their presence detected and proper remedies or preventives applied.

We have called attention to some comparatively new species of destructive insects in this State as well as some important imported plant diseases. It is very desirable that readers aid us by watching for the occurrance of these, in order that we may help to suppress them wherever they may occur in this Commonwealth. As serious as has been the loss by the San José Scale, amounting to millions of dollars in this State, we must honestly assure our citizens that there are pests and plant diseases of far greater destructive possibilities than this from which we have suffered so much. The scale scare and scale trouble should now be a thing of the past, as we have proven, by demonstrating how to control it satisfactorily and economically. For some of the other insects and diseases, however, more recently appearing, satisfactory remedies or preventives are not known. These yet remain as subjects for most important investigations. Let us work together!

THE DEMONSTRATION ORCHARDS.

The Demonstration Orchards that are now established in most of the Counties of this State are worthy of careful study by every person, growing even a few fruit trees. The pruning demonstrations have already been given, and where San José Scale is present the spraying demonstration for this pest has also been held. The Codling Moth demonstration will come next, and must be just after the blossoms fall. All citizens interested in good fruits should attend the demonstrations and see how to prevent wormy apples, pears

and quinces. Other demonstrations will be announced and given in due time. Watch the announcements in local papers.

How Late Can We Spray For Scale? Spraying for San José Scale can continue until after the buds burst and the green leaves appear and the pink of the blossom is first seen, but not after the blossoms commence to open. Do not spray any plants while in bloom unless it is desired to kill them.

This Bulletin will be sent while the supply is not exhausted to all persons in this State requesting it, and particularly to agricultural organizations and clubs of various kinds.

Correspondence on these topics is solicited. Send specimens and communications to H. A. Surface, Economic Zoologist, Harrisburg, Pa.

INSECT PESTS AND THEIR WORK.

It is of great importance to know the names of insects that are effecting destruction to crops of various kinds. In many cases the pests themselves are not easily seen, but their work remains so apparent that growers are familiar with this rather than with the insects. It is our effort in this Bulletin to describe the appearance and effects of some of the most common and destructive insects, and also the pests themselves, in their destructive stages, in such a manner that the growers may be able to recognize the source of insect trouble and apply the known remedies for each, after determining the name of the pest or cause of the damage. It must be recognized that insecticides should vary in composition and time of application in accordance with the kind of insect for which they are to be applied. No fruit grower merely "sprays." He makes a careful study of the pests on his trees and applies the right material, at the right time, and in the right way to destroy, control or prevent these pests. The kind of insecticide to use, the proportions of materials necessary, the methods of making the mixture, the exact date of application, and the method of application, all are of fundamental importance and should be studied and learned. They have been discussed at length in previous issues of these Bulletins, a few copies of which yet remain in the office of the Economic Zoologist for free distribution to persons who need them.

Before the subject of insecticides, however, is that of the name of the pest for which the material is to be used. This really must be learned first. Every person going into the business of growing plants or keeping live stock, poultry or other living creatures of any

kind should first become acquainted with the diseases and enemies of those plants or animals. He should know them by name and by description, as well as by effects or results. By having this knowledge he can easily find the proper remedies or preventives in publications on such subjects.

In the following article, insects are discussed according to the plants they infest, but it must be remembered that some insects are liable to attack a great many varieties or species of plants, while others may be limited to but a few or even one only. When an insect like the Codling Moth is described under "Apple," this does not imply that it attacks no other fruits, and the description of its work for the fruit under which it is discussed is practically the same as for its effects on any other fruit or plant. If the description and name can not be found under one particular kind of fruit, it should be sought under another, which it may also attack. Details of remedies have been published in previous issues of these Bulletins, especially in our issue for last May, copies of which may be had by application to this office.

APPLE PESTS.

Aphids or Plant Lice: These are small, round-bodied greenish insects, with two long antennae or feelers and a piercing mouthpart by which they pierce the tissue of the leaf or growing twig and suck the juices, after having injected a saliva that is always poisonous and detrimental to the tree. Plant Lice belong to the group of insects without metamorphosis, and consequently they do not have a worm-like larval stage. The Apple Aphis remains during the winter in the form of black shiny eggs on the twigs of the tree. At this time spraying with such insecticides as are effective in killing scale insects will destroy them. About the time the buds are bursting the young Aphids hatch from the eggs and commence to suck the juices from the new green parts. This is the best time to kill them by mild contract sprays, such as dilute Whale Oil Soap, eight per cent Kerosene Emulsion, Tobacco Decoction, or dilute soap washes of other kinds. As they feed on the under sides of the leaves, the infested leaves become deformed or twisted and curled in such a way as to form protecting places for the insects within and sprays can not reach them. Consequently after the leaves are curled it is impossible to kill them by spraying, but if delayed until then the infested twigs may be bent over and dipped into pans containing the contact insecticide, or the leaves may be picked and destroyed.

The Codling Moth: The Codling Moth is the insect that feeds on the seeds and around the core of apples, pears and quinces. In its destructive stage it is a pinkish white larva which comes from an egg laid on the fruit or leaf by a small winged moth, which flies at night and is properly called the Codling Moth. This egg is laid about the time the trees are in bloom, and shortly after the flowers fall the little larva or worm hatches from the egg and generally crawls to the blossom end of the fruit, where it usually makes its entrance. There is no remedy for it after it has entered the fruit, but if a spray of arsenical poison be used at the right time, it will be killed with it when it takes the poison in attempting to gnaw through the surface of the fruit to reach the interior.

The best remedy is Arsenate of Lead, two or three pounds in fifty gallons of water, and the next best is Paris Green, one third pound in fifty gallons. Instead of using the poison in water alone, it is yet better to make the Bordeaux Mixture by the use of four pounds of Bluestone and six pounds of Lime and a fifty-gallon tank or barrel of water, and add the poison to this. For pears, apples and quinces this formula is all right, but for peaches and plums it should be reduced by using one-half of the materials in the full amount of water.

To prevent the further appearance of the Codling Moth, fallen fruits should be destroyed as soon as they drop, either by gathering them or by keeping pigs or sheep beneath the trees. Also, bands may be put around the trees in mid-summer to catch the larvae when they seek places to spin their cocoons and transform into their winged stage. However, if the bands be not examined at least once per week to kill the insects that collect beneath them they are worse than as though nothing had been used, for the reason that they will furnish hiding places for these pests rather than force them to transform where woodpeckers and other natural enemies would be liable to find and destroy them.

The spraying for the Codling Moth should be done just after the petals or flowers fall, and again in a week or ten days from that date. There are two broods of the Codling Moth per year, but if the spraying be thoroughly and properly done for the first brood it will not be necessary to spray in July or August for the second brood.

The Bud Moth: This is the insect which does its destruction when in the larval or worm stage by eating the interior of the buds of apple and other trees. The chief destruction is done in spring and may be quite serious, because the undeveloped leaves are then so small that one bite may cause deformity of an entire leaf as it further developes. For the Bud Moth, spray with Arsenate of Lead or

Paris Green as soon as the buds burst and the green leaves are showing, and repeat just before the blossoms open. Carefully avoid spraying blossoms when in bloom.

Bitter Rot: Bitter Rot, as a disease of the fruit shows itself in the form of dark-colored rotten spots, and causes the fruit in such spots to taste very bitter. It is important to prevent it by spraying with the Bordeaux Mixture before the blossoms open and again just after the flowers fall. This second Bordeaux spray is the spray with Paris Green added to be used for the Codling Moth. This Bordeaux spraying should be repeated once every ten days for a few weeks.

Borers: The Common Borers of Apple, Pear and Quince are the larvae or grubs that work beneath the bark of young trees. These generally enter and work where the bark has been injured or where the injury by sunscald has already started. They are rarely found in the branches and seldom in the trunks of large trees and perhaps never at the roots. There are two kinds of Borers attacking the growing trunks of young apple, pear and quince trees. One of these is called the Round-headed and the other the Flat-headed Borer. They are the larvæ or grubs of beetles belonging to different families. (These must not be confused with the Shot-hole Borer, discussed under "Peach.") Their presence is often made manifest by the dark, flattened, discolored spots in the bark over them. The bark is generally dark and flattened at such places, and tapping on it shows that it is hollow beneath. Sometimes they show evidences of their presence by means of holes cut through the bark and fresh "sawdust" dropping out. To get rid of them it is possible to cut them out after they have entered, or puncture them with a long, sharpened, but very soft, wire, which will follow their winding burrows, or drive sulfur matches into their holes and let them remain. It is also advisable to inject carbon bisulfide in their holes with a spring-bottom oil can and plug these with clay or mud. The best treatment for Borers of Apple, Pear and Quince is to prevent their entering the tree by painting with pure unboiled linseed oil and white lead, from the lower branches to the ground, about the last of June. This also prevents injury from mice and rabbits.

The Case Bearers: The Case Bearers are small insects which in their larval stage crawl over the leaves or twigs, carrying with them a small protecting case. In fact, there are two or three species of these Case Bearers, one of which carries a twisted tubular case and another carries a case shaped like a cigar, and hence is called the Cigar Case Bearer. It is impossible to spray them with contact insecticides because they are protected within their cases. They are killed by using poison sprays applied at the same time and in

the same manner as for the Bud Moth. The mature Case Bearer is a very small moth. Their injury is, of course, done in the larval stage, generally in the very early part of the growing season, and consists in eating holes in the leaves.

Canker Worms: The Canker Worm is sometimes called the Measuring Worm, Measurer, Loop Worm, Looper, "Tapeworm," and other common names. There are two species, one of which is called the Fall Canker Worm because they appear in the mature state in the fall of the year, and the other the Spring Cankerworm, because they live through the winter in the ground and transform to the adult state in the spring, and then crawl to and up the trees. The females are wingless and have no way of reaching the branches of the trees, where the eggs are deposited, other than to crawl from the ground to the twigs for this express purpose. While they are moths, they do not resemble moths in general from the fact that they are without wings, although the males have wings and fly readily from place to place. The larvæ are Measuring Worms that crawl along by looping during late spring, after having let themselves down from the trees by means of suspending silken webs. In Pennsylvania the Fall Canker Worms have, during recent years, been in the habit of remaining in the ground until spring and appearing at the time for the spring species.

They destroy the foliage of nearly all kinds of shade and fruit trees by eating it. They become full grown about the middle of June, when they disappear almost suddenly and enter the ground to pupate and remain during the remainder of the year.

Because all the female Canker Worms must crawl to the living twigs to deposit their eggs, it is possible to prevent this by putting bands of very loose cotton, rolled outward, or some sticky substance, or loose wool, around the trunks of the trees in February and March. After the young commence to eat the leaves, it is possible to spray with arsenical poison, such as Arsenate of Lead, two pounds in fifty gallons of water, and thoroughly destroy them as promptly as possible. The younger they are when sprayed the better the results.

Frog-Eye or Round Leaf-Spot: This is the name of a fungous disease of the leaves of apple trees, which appears to have come into this State during very recent years from the South, and is spreading northward with very destructive effects. The name of the disease is given from the fact that it produces round brown spots in the green leaves, which very much resemble the round ear drums or so-called "eye spots" seen on the sides of the frog's head just back of its eyes. Several of these spots may occur on one leaf and cause the leaves to fall prematurely and result in the produc-

tion of fruit of only poor grade, if any. As for other fungous diseases, these are easily prevented by spraying at the proper times with the Bordeaux Mixture. In an orchard where infection occurs the spraying should be done about once every two weeks during the summer, and also repeated after a hard rain washes the leaves.

Apple Leaf Miner: This comparatively new destructive insect in this state makes a mine or tunnel in the green tissue of the leaves between the two layers or coverings, and as several may occur within one leaf they have a destructive effect and results similar to those of the Frog-Eye fungus. The mines or tunnels made by this insect can easily be recognized by the fact that they are trumpet-shaped or worm-like in appearance. The larva which makes them transforms into a pupa and in the spring developes into a very minute moth which lays the egg on the leaf, and the larva hatches from this. Where this pest occurs the falling leaves should be gathered and burned as completely as possible. A spray of arsenate of lead and Bordeaux Mixture, kept on the leaves during the spring and the early summer to destroy the young larva at the time they hatch from the egg, and before they are concealed within the leaf, is the only practical remedy that can be offered at this time besides the destruction of infested foliage or fallen leaves to prevent its spread. It is urgently requested that readers should also watch for this insect and send reports and samples of infested leaves to this office. Special attention must be given to this pest in this State before it spreads further.

Railroad Maggot: This name is given to a white "worm" or maggot which is really the larva of a fly, and should consequently be called a maggot. It bores through the pulp of the apple, making its path in a winding manner through the fruit, and doing even greater damage than does the destructive Codling Moth. Its work is to be known at once by the small winding path made through the pulp of the fruit. It does not attack the seeds or core, as does the Codling Moth. It has comparatively recently come into this State, chiefly from the North and East, and it is very important for fruit growers to watch for it and report its occurrence to this office, in order that we can help to suppress it before it becomes more generally extended over the orchards of this Commonwealth. It may, in time, become by far our most important apple insect pest.

The egg is laid on the fruit by a gray fly, slightly larger than the House Fly, and the larva is about one-fourth the size of the common or average dressing pin. Its presence is readily recognized by its winding tunnel bored through the fruit. Where it occurs fallen fruit should be gathered promptly and completely and fed to pigs, or the hogs or sheep should be permitted to have free range of the

orchard. It is very important for the occurrence of this pest to be reported by observers to this office.

Oyster-shell Scale: The Oyster-shell Scale is generally a dark gray or brownish color, but not white, forming a perceptible ridge on the bark where it is fixed, two or three times longer than wide, and curved in the form of an oyster shell. From the central part of Pennsylvania southward there are two broods per year, the young appearing about the middle of May and again about the early part of August. The female lays her eggs beneath the old shell and dies, and the pearly white eggs remain unhatched under the shell during the winter. Their injury is done by injecting a poisonous saliva into the inner bark and sucking the sap therefrom, according to the habits of other species of scale insects and Plant Lice. Remedies are discussed in our Bulletin for last November.

The San Jose Scale: This little but terrible pest is about the size of the dot over the letter "i" in this Bulletin, and is perfectly circular, with a little point in the center. Often they occur in such numbers as to completely incrust the bark of the tree. They may fix upon any portion of the tree above ground, including the leaves or fruit. They often cause the inner bark, especially of pear trees, to become red by their poisoning, and cause little red specks on the growing shoots and fruits. They are to be killed by the methods advocated in previous numbers of this Volume.

The Scurfy Scale: This is one of the older scale insects on fruit and shade trees, given its common name from the fact that it resembles a flake of scurf or dandruff, such as is sometimes seen in the hair. The female is gray and fan-shaped, and about the size of the letter "v" used in this Bulletin. The male is quite small and narrow, being no larger than the body of the letter "i" in this print. Beneath the scale of the female are to be found the purple eggs during the winter time and about midsummer. There are two broods per year, the first hatching about the third week of May, and the second hatching during the early part of August. The life history, effects and remedies are practically the same as for the Oyster-shell Scale. Spray when the trees are dormant with such insecticides as are recommended for the San José Scale, or spray just after the eggs hatch with mild contract insecticides, such as are recommended for Aphids or Plant Lice.

The Tent Caterpillar. As common and conspicuous as this pest is it is often confused with other species of caterpillars or larvæ of moths. This name is given only to those hairy caterpillars which hatch from a band of eggs encircling the twigs of cherry, peach, wild cherry and a few other trees, and form tents of thick white sheets of webbing in the forks of the branches on the trees during

the months of May and June. The tents may remain in a more or less dilapidated condition during all the year, but the worms or caterpillars do not remain in them after the latter part of June. This term should not be given to the Webworms, which construct loose web coverings over the leaves of various fruit and forest trees later in the year, nor should it be given to the caterpillars that denude walnut trees and form bunches of cast skins on the trunks. Tent Caterpillars are to be killed by clipping off the egg masses during the winter and spring and by spraying with arsenical poisons as soon as they appear and commence to form their tents in the spring, and by removing their tents with a brush on the end of a pole or by shooting them out of a tree with a shotgun loaded with only powder and paper. If a torch be used for burning them out, it can be made effective, but is liable to injure the tree, unless one be careful to hold it near the brances only a very few seconds.

Apple Scab: This is a fungous disease which causes the scabby condition of fruit and leaf, and it is to be prevented by spraying with the Bordeaux Mixture in the same way and at the same time as for Frog Eye and other fungus diseases.

Woolly Aphis: This is a dark blue plant louse, which secretes a white waxy or woolly substance over its body that protects it from cold, heat and water, and also from its enemies. The white covering and the number of these insects together form what resembles a small tuft of wool, from which the common name is derived. They may live on the roots of trees, or on the trunk, branches or leaves. Where there are injured spots the Woolly Aphis is especially liable to be found, and by its continuous injection of a poisonous saliva and sucking the sap of the tree at such place, it causes a permanent injury and often results in the formation of knots or galls. When it occurs on the roots of trees the best remedy is to uncover the infested roots and put immediately over them a liberal sprinkling of finely ground tobacco leaves or tobacco dust and replace the soil. The Woolly Aphis above ground can be killed by painting or spraying the spots which it infests with strong soap solution, oil emulsions, strong tobacco decoction, lime-sulphur wash, Niagara Spray, or any other good contact insecticide.

APRICOT.

(See discussion of Peach and other stone fruits.)

ASPARAGUS.

Asparagus Beetles: There are two kinds of Asparagus Beetles, both of which injure the asparagus plants by eating the green parts and making holes in the stalks, and by laying their eggs upon the plants, from which eggs, grubs or larvæ hatch and feed upon the green parts of the plant. In habits, effects and remedies the two species are similar, but the beetles are distinct, the one known as the Common Asparagus Beetle being found much more extensively in this State.

The Common Asparagus Beetle is blue-black in color, with red thorax and lemon-yellow and dark blue wing covers, with a redish border. It is less than one-fourth inch in length. The less common species in this State is called the Twelve-spotted Asparagus Beetle, and may be distinguished by its color, which is orange red, with six black dots on each wing cover, making twelve black dots on the upper side of the orange red insect. It closely resembles the ripening asparagus berry. This species of insect has been introduced in to our State from the Southeast and it is gradually spreading northward and westward over the State. We should like to know its range, and ask for specimens and information concerning its occurrence in this Commonwealth. Both species deposit rows of small dark eggs, placed endwise on the plants. The remedies for both are the same, and consist in cutting low the entire patch of asparagus, destroying the food supply, or dusting with flour and pyrethrum, or permitting a portion of the patch to remain uncut and dusting it with flour and Paris Green when damp with dew, or spraying with some other arsenical poison, especially Arsenate of Lead, which will stick to the plants that are not to be used for food.

Asparagus Rust: This is a disease which occurs where the plants are too damp and the air circulation is poor. It is to be prevented by cutting all the plants low and frequently, and spraying with Bordeaux Mixture during the season after the cutting stops. Cut and burn the rusty plants in the fall as soon as they ripen or commence to die.

BEANS.

Anthracnose or Red Spot: This is the disease which causes dark or red cancer-like spots in the bean pods. The remedies are discussed in our May Bulletin.

Mildew: Mildew is a common plant disease, which may attack beans, carnations, roses, peas, violets and other plants, and is to be prevented by spraying with dilute Lime-sulfur Wash, with some extra free Sulfur added, or with Potassium Sulphide, or dusting with very fine Sulfur, when damp.

Weevil: The Bean Weevil is a small insect several of which sometimes feed inside one bean. The eggs are laid in the pods when the beans are growing, and the larvæ bore into the interior of the bean and feed during the fall and winter. To destroy them the beans should be fumigated with Carbon Bisulphide or Hydrocyanic Acid Gas as soon as they are gathered, and again before they are planted in the spring.

CABBAGE AND CAULIFLOWER.

Cabbage Worm: The common green Cabbage Worm reaches a length of about one inch, and appears to be covered with delicate green velvet. It eats the leaves of Cabbage and Cauliflower and proves very destructive. It is the larval or immature form of a white butterfly, of which two species are common. It is to be killed without any trouble by spraying with Paris Green in water, or, better, Arsenate of Lead in water, or by dusting the Cabbage with flour, twenty parts and Paris Green one part. If applied in a dust it should be while the plants are damp with dew. When applied to heads that are three-fourth or less grown, there is not the least danger in using poison, and there will be no trouble of loss by the worms.

Cabbage Plant Lice: These are the minute insects belonging to the large family of Aphids, which are at times seen covering the leaves, especially the under sides. Aphids or Plant Lice should be too familiar to every grower of plants to need description. When they are present on Cabbage they should be destroyed at once, by either picking off and burning the leaves they infest or by spraying with an up-turned nozzle, which will be sure to reach them on the under sides of the leaves, using ten per cent. Kerosene Emulsion, with some Resin or Whale Oil Soap to make it stick to the plants. Whale Oil Soap Solution alone, one pound in six gallons of water, will destroy them, as will also a strong solution or decoction of tobacco.

Caterpillars: Various kinds of caterpillars, or larvæ of moths, may be seen at times eating holes in the leaves of heads of Cabbage. These should be destroyed by spraying with arsenical poisons, such as Arsenate of Lead, or by dusting with Arsenites, or by

hand picking. It is our opinion that Cauliflower can not be sprayed with arsenical poisons with the certainty of safety that can be felt in spraying Cabbage. Therefore, we advise the use of an insect powder, such as pyrethrum or hellebore, instead of arsenites in treating Cauliflower.

Clubroot, Bigroot or Bigfoot: This is a disease of the stalk of the Cauliflower and Cabbage by which it swells to enormous size and stops the growth of the plant. The disease may be in the soil in which the plants are grown, or it may be in the soil in the field in which they are set, or it may be on the seed and infect the plant bed and later the soil in the field. The best preventive is to mix Lime and Sulfur, about ten parts of the former to one of the latter, and stir a handful of this into the soil at each place where a plant is to be set. Other remedies are discussed in our May Bulletin.

Harlequin Bug: This insect is a true bug, having a long suctorial bill. It is brightly colored or marked with red and black, and being in the form of a double triangle it is readily recognized. It is a southern insect, coming into this State from the South, and sucks and blights cabbage and similar plants, but does not gnaw them. It is to be found upon Cabbage, Cauliflower, Kale, Mustard and other cruciferous plants. We wish records of the occurrence of this insect in this State, and shall thank our readers to report it, in order that we can make charts of the area infested by it. To destroy it, either pick it by hand or sow a small trap crop of Mustard, and after the insects congregate upon the plants spray them with Kerosene.

The Root Maggot: This insect is the larva of a fly about the size of a House Fly. In the stage in which it infests the roots, it is a maggot reaching a length of slightly over one-fourth inch. It feeds upon the soft tissue surrounding the roots of Cabbage, Cauliflower, Radishes, Turnips and other cruciferous plants, probably also including Mustard and wild plants of the same family. It sometimes causes the plants to wilt down suddenly as though their roots had been cut off, or as though their leaves had been scalded. Upon examination of the roots of such plants, they are found to be stripped of their outer or fleshy layer. This pest is best prevented by putting a disk of tarred paper, about three inches in diameter, closely around each plant at the time it is set into the ground. Split the paper to the centre so that it can be put around the plant and firmly pressed down to the ground. Several remedies are mentioned on page forty-five of this volume. The tarred paper disks are best to prevent its entering the roots and the carbolic emulsion will kill it after entering. It is not so destructive on the late Cabbage plants, and consequently it is advisable to plant the bulk of the crop for home use for winter, for kraut, etc., at a late planting.

CARNATIONS.

Anthracnose or Rust Spot: This is a plant disease attacking the various parts of the plants in spots, causing death to the tissue, and in fact acting as a vegetable cancer. It is to be prevented by spraying abundantly with the Bordeaux Mixture or Cupram.

Mildew: (See Mildew on Bean.)

Red Spider: The Red Spider or Red Mite is an insect which is at times very destructive to plants. Those plants that are subject to Mildew are especially liable to be attacked by the Red Spider. It is a suctorial creature, and therefore can not be killed by internal poisons or arsenites. It is not always red, but may be white or greenish, and this common name, therefore, may at times be misleading. Where a strong jet of water can be had it is advisable to wash the infested plants by such means, knocking the pests from them. Also it is well to spray with almost any materials recommended for Mildew. Sulfur and its compounds are specifics against the Red Spider. The dilute Lime-sulfur Wash, made so dilute that it will not injure the foliage, and having some free Sulfur added, will give excellent results for Red Spider. A dust of Sulfur and Lime, or Sulfur and Flour will also be useful in suppressing this pest. Potassium Sulphide Solution with some Flowers of Sulfur added, is especially good, while results can also be obtained by the use of Whale Oil Soap or Kerosene Emulsion.

CHERRY.

Cherry Aphis: The Cherry Aphis is a plant louse, but instead of being green in color, as are those which have been previously discussed in this Bulletin, it is of a dark brown color. The Brown Aphis is also sometimes found on Peach. The plant lice of this color are more hardy or less easily killed than are the green aphids or plant lice. We have several records of their having been destroyed and the trees cleaned nicely by the use of the boiled Lime-sulfur Wash, applied in the spring while the buds were swelling. We recommend this for Cherry, Peach and Plum each year, whether the San José Scale be present or not. Also, a strong solution of Whale Oil Soap, one pound in five gallons of water, strong Tobacco Decoction, or 12 per cent. Kerosene Emulsion, applied as a spray, will kill them.

Black Knot: The Black Knot is one of the important plant diseases in this State against which there is legislation, and for which the

law should be strictly enforced. It is to be recognized as a hard rough black fungous growth, causing deformity of the branches, seen on the twigs and branches of plum and cherry trees as black knots of varying sizes and shapes. The only known remedy is to cut it out and burn it, sterlizing the knife occasionally by dipping it into turpentine, Bordeaux or Lime-sulfur wash, and washing the freshly cut surface of the branch with paint, turpentine, Bordeaux Mixture, or some other sterlizing material. There is no spray that will cure Black Knot, but spraying with Lime-sulfur Wash or Bordeaux Mixture will greatly aid in preventing its spread. It should be cut and burned promptly wherever seen.

Cherry Curculio: The Cherry or Plum Curculio makes "wormy" cherries. The damage is done in the larval or grub stage, from which it enters the ground, transforms to the pupa, and remains over winter to come out in the spring in the form of a snout Beetle. The trees should be sprayed with Arsenate of Lead and Bordeaux mixture, using two or three pounds of Arsenate of Lead in fifty gallons of Bordeaux just after the buds burst, but before the blossoms open, and again with the same liquid soon after the petals or flowers fall, and this spray should be repeated again in a week or ten days. It is advisable to cultivate the ground about the middle of July under infested trees and permit fowls to run in the orchard or yard where cherries and plums grow. Pick off the fruit that indicates that it is stung or infested, and feed to the poultry or pigs and have fowls ready to destroy the fruit which falls early because infested with "worms."

Cherry Fly: A new cherry pest, the adult is a spotted-winged fly, and the larva is a maggot in the fruit. Remedies, as for Curculio.

Rot: The Brown Rot or Monilia of Cherry is a disease which infects stone fruits, such as Cherry, Peach and Plum. Next to the Curculio causing wormy fruit, rot is liable to be the worst enemy of the cherry fruit. It is sometimes called the Ripe Rot, because it comes almost suddenly about the time the fruit is commencing to ripen. It can be prevented by faithfully spraying with the Bordeaux Mixture, as described for the Curculio, but keeping up the spraying about once every two weeks during the growing season, and repeating this when the leaves and fruit are washed clean by a hard rain. After the fruit is full grown and commences to show color of ripening it should be sprayed with Cupram solution, which is a colorless fungicide and will leave no stain. Rotten fruits of Peach, Plum and Cherry should never be permitted to remain on the trees nor left on the ground, but should be gathered and burned to prevent the spread of the millions of rot germs that can be seen as a white powdery covering on the surface of such fruits.

The Leaf Slug: The Cherry Leaf Slug is one of the slug-like insects resembling a shell-less snail, which lives on the leaf by devouring the epidermis and causing the leaves to appear brown or scorched. It is a moist, dark, almost shapeless mass, and is one of the most easily destroyed insects that infest the foliage of fruit trees. Similar larvæ destroy the leaves of Plum and Pear trees, and are to be killed by dusting with Paris Green with freshly slacked Lime. One part of Paris Green should be added to twenty parts of Lime, or spray with any of the arsenical poisons or dust with Hellebore. Any of the spray liquids for killing leaf-eating insects, such as caterpillars, will destroy these Slugs, and because their bodies are slimy and moist they are killed by the Lime dust, the same as are the larvæ of the Asparagus Beetles.

CORN.

Corn Worm or Boll Worm: This is the larva of a grey moth over one inch across the wings, which is found feeding on the grains of soft (green) corn beneath the husks, and also in bolls of cotton and sometimes in ripe tomatoes. It is a striped larva, reaching a length of over one inch, and is sometimes common in the ears of sweet corn. It should be destroyed by picking by hand; and wherever ears of corn show signs of infestation, the husks should be opened and the larva destroyed. Also, plow late in the fall to kill them while they are hibernating.

Corn Root Worm: This is a larva which feeds on the roots of young corn in the spring of the year, and consequently does considerable damage. It must not be mistaken for the cutworm, as it works at the roots themselves, and does not cut off the stalk. Also, where this pest is found growers should practice rotation of crops, and avoid frequent planting of corn in the same ground. This is the best means of overcoming this pest.

Cutworms: These insects are the young or larvæ of dark gray, common moths, such as fly at night, and are often called "millers." In their larval stage they feed chiefly on the roots of vegetation beneath the surface of the ground, and generally remain concealed during the day time, feeding mostly at night. They come from eggs that were laid by the moths, generally near the roots of grasses, and when a sod field is plowed they remain in the soil ready to attack whatever crop follows. They are thus sometimes forced to appear in numbers as enemies of the young corn plants. They cut off the plants beneath the surface of the ground and eat the tissue, but do not seem to draw it down into the holes in the ground as does the

Earthworm. They are best prevented by practicing such rotation of crops as to prevent planting corn upon grass sod, and especially upon a sod of long standing. Where it is necessary to plant corn on sod, the ground should be plowed in the fall and cultivated as late as possible and again cultivated in the spring as early as possible. It should be allowed to lie fallow until late spring and planted late. This is to kill the Cutworms or starve them out. In addition to this, poison bait should be used, made with Paris Green and sweetened bran, and dropped occasionally over the ground they inhabit. After the corn has sprouted in the spring and the Cutworms commence to destroy it, these pests can be killed by poison baits dropped over the ground in the evening when it is damp, or placed under boards. Also after a rain they can be found by going over the fields and watching for places where they have freshly broken the soil, like miniature moles, and pick them by hand and destroy them.

Smut of Corn: These are the large black balls that form on various parts of the stalk, leaves and tassel. Such masses should be gathered and burned before they become dry. Do not destroy them by throwing them on the manure heap nor permit them to remain on the ground.

Root Lice and Ants: The small holes freshly made beside the stalks of young corn growing in rows are often quite conspicuous, and indicate the presence of Ants at the roots. The stalks may be feeble and indeed much impaired by the injuries caused, not by the Ants, but by Root Lice which the Ants protect and which in turn suck the sap from the corn plants and often injure them materially. To prevent Ants and Root Lice, practice rotation of crops, plow in the fall, cultivate late in the fall and again early in the spring, keep down all weeds, and cultivate frequently. Plant the corn with fertilizer and thus stimulate its growth at a time in its life when it is most likely to be enfeebled by numerous small pests.

Web worms: These are the small larvæ or so-called "worms" that are often seen in many young stalks of corn. They bore through the leaves before they are unfolded and feed in the heart of the stalk. They thus do a great deal of damage because they injure it while it is young. They spin silken webs over themselves and thus find protection. There is no known remedy for them after the corn is planted. Fall plowing and cultivation, as for Cutworms and Root Lice, is recommended. Rotation of crops, and avoidance of planting corn on sod infested with these pests are especially advisable. Stimulate by commercial fertilizer and cultivate thoroly.

Wire worms: The insect that is properly called the Wire worm is a somewhat hard-shelled beetle larva, which is the young or immature stage of the Click Beetle or Snap Beetle, or "Snapping Bug." The eggs are generally laid in sod, and the young Wire worms live

there, but when the sod is turned down the larvæ continue to feed on the plant tissues in the soil. There is practically no remedy for them after they once commence their depredations on the growing corn in the spring. It is said that they can be poisoned by dropping slices of potatoes, poisoned with Paris Green and flour, on the ground in the evening when it is damp, and putting such poison bait beneath boards. The poison bran is also to be recommended. To avoid them it is best to rotate crops, so the corn does not follow grass, plow late in the fall, and otherwise treat the ground as for Cutworms, Root Lice and Webworms.

CUCUMBER, MELON AND SQUASH

Downy Mildew: Downey Mildew is a disease that causes these plants to look as though sprinkled with flour or covered with a light or downy substance. To prevent this, spray them with the Bordeaux Mixture, and gather and burn the vines as soon as the desirable portion of the crop is gathered.

Blight: Melon Blight is the name of a disease which causes the leaves to turn black or brown and may destroy the entire crop. The best treatment is abundant and thorough spraying with Bordeaux Mixture. In growing melons where this is liable to occur, they should be planted with a view of driving the spraying apparatus between some of the rows for the purpose of spraying them. The grower can use either a field crop sprayer or barrel sprayer with long hose. We have had occasion to see the good results of spraying with Bordeaux Mixture for Melon Blight.

Borers: The Borers of squash, pumpkin and similar vines are white larvæ, which are the young of moths, which fly by day and look much like wasps. They are called clear-wings and are not easily caught or trapped. Unlike most moths they become dormant or inactive toward evening and remain so in the morning. These mature or winged insects at such times, and also when the weather is rainy, cling to the under sides of the leaves, and there may be found and killed by hand. They lay their eggs on the vines or large stalks, and into these the Borers eat their way, and there they remain and feed until they are mature. They can be killed by puncturing them with a sharp pointed wire inserted into the stalks and pushed along in the hollow until the larvæ are pierced, or they can be killed by slitting the vines lengthwise to reach them. The cutting should be done lengthwise instead of crosswise. The vines should be covered at intervals to permit them to take root at several places, and they will then thrive even though they should be

cut off near the original hill or root. The borers can be killed at the times the eggs hatch and the young larvæ commence to feed, if the vines are at that time dusted with Paris Green and flour, one part of the former to twenty of the latter, or by spraying with arsenical poison.

Squash Bugs: The Squash Bug is a long brown stinking bug that is often found on the squash, cucumbers and similar vines. They are too well known to need further description. They lay a number of large reddish brown eggs, about one-eighth of an inch apart, and from these hatch small active bugs with long legs and antennæ, which live in colonies and suck the juices from the leaves and also poison them by injecting poisonous saliva, causing the leaves to turn dark and wither at the infested spots, looking very much as though scalded with hot water. Since they are not chewing insects, they cannot be killed with arsenical poisons, but hand picking, contact sprays, traps and other means of destruction must be used.

Striped Cucumber Beetles: These are small, yellow and black striped beetles, about one-fourth of an inch in length, that are to be seen in the spring on the leaves of cucumbers, melons and similar vining plants. The beetles eat holes in the seedling leaves and other leaves as fast as they appear, and in fact may destroy the entire young plants. They lay their eggs in the ground very near the plants they infest, and their larvæ feed on the roots of the plants, eating away the outer soft tissue and causing the plants to wilt almost suddenly as though they had been frozen or the stalks had been cut off. To prevent injury by this insect cover the plants with nets until they are well started, or dust them with Paris Green dilute with flour or with air-slacked lime scented with terpentine over which place mosquito netting.

For the larvæ around the roots use tobacco dust in abundance. Not only will it destroy the pests, but it will be a good fertilizer for the plants.

CURRANTS.

Currant Fruit Worm: This is the name of the insect which lives as the larva inside the currant berry and is properly called the currant Maggot. It is the larva of a fly and is difficult to destroy, owing to the impossibility of reaching it with either contact insecticides or poisons. Prematurely ripening fruit should be picked and fed to the fowls or pigs, and all infested fruit should be gathered on the bushes or on the ground and destroyed or crushed under foot. The fallen leaves should be raked together and burned, and the

plants should be sprayed with arsenical poisons, such as Arsenate of Lead and Bordeaux Mixture, soon after the blossoms fall, and repeated two or three times at intervals of about two weeks. Of course, the fruit should not be used while a trace of the arsenical spray remains, and it should not be applied after the fruit is more than half grown.

The Currant Worm: This is the name of the green and black spreckled larva that is often seen eating the leaves of currant bushes and reducing them to mere ribs. It is the larva of a wasp-like insect called a Sawfly. The white eggs are laid in rows on the under sides of the veins or ribs of the leaves. After they feed and become full grown larvæ they enter the soil where they spin cocoons and remain during the winter, to come forth the next spring in the winged state. They are easily destroyed by dusting with Hellebore or applying a spray of Hellebore stirred in water, one spoonful to a gallon of water is sufficient. A good dusting material is made by mixing one pint of Hellebore with four or five parts of flour and keeping it in a closed vessel for a few days or longer. The Currant Worms are also killed by spraying with arsenical sprays, like Paris Green or Arsenate of Lead, and with contact insecticides such as Whale Oil Soap, Kerosene Emulsion or freshly slacked lime.

ELM.

Elm Leaf Beetle: The adult form of this beetle is a dark-colored, small, hard shelled insect, not more than one-fourth inch in length, which is to be found in the early spring in the grass or soil around the base of elm trees, and which lays its eggs on the elm leaves. The larvæ feed on the leaves, eating holes through them, and make them appear quite netted. They effect a great deal of injury by the defoliation of the trees. Fortunately, they do not occur in many portions of this State, but we should be glad to have specimens and reports of their occurrence from the parts which they now inhabit. Infested trees should be sprayed with Arsenate of Lead or Arsenite of Lime as soon as the first leaves appear and sprayed again and repeated as often as any of the pests are found present upon them.

The Tussock Moth: This is a common enemy of many shade and fruit trees. In the larval stage it is easily recognized as one of the most familiar hairy caterpillars. It has long tufts of black hairs like pencil points, projecting from it and shorter knobs of red and white hairs arranged along its back. It feeds on the leaves of most kinds of shade trees, and is especially injurious to trees along village and city streets. It is the chief enemy of the trees in the streets

and parks of Philadelphia. When it becomes grown it attaches itself to the bark of the trunk or larger branches and spins a loose cocoon, using also the larval hairs for this purpose. Within this a chrysalis forms, and later the moth appears with vestigial and useless wings. She cannot fly, and remains on the old cocoon where she lays white eggs and covers them with a frothy substance which becomes dry and hard. It is not difficult to gather and destroy these egg masses on the old cocoons as they are seen upon the branches and trunks of the trees. Doing this in the spring, or touching them with sponges dipped in a soap or oil solution will be effective. A saturated sponge may be attached to the end of a pole and dipped in Kerosene or Crude Petroleum, and they can be touched in this way. When the larvæ are present spray with arsenites to poison them on the leaves in midsummer. The egg masses of the second brood should be destroyed by hand.

GOOSEBERRY.

The Four-lined Leaf Bug: This is a bug or suctorial insect belonging to the suborder Heteroptera, which destroys the leaves by puncturing them with its poisonous bill, causing them to turn dark and die. It is to be recognized by the four stripes running lengthwise on its body. From these it takes its name. It can be killed by spraying with Kerosene Emulsion or Whale Oil Soap.

Gooseberry Fruit Worm: (See Currant Fruit Worm).

Leaf Blight: This is a disease of the leaves, causing them to turn dark and die or sometimes become deformed. Spray with the Bordeaux Mixture, shortly after the blossoms fall, and with Cupram after the fruit becomes larger, and with either fungicide after the fruit is gathered.

The Stem Borer or Girdler: This is the insect which bores in the stems of currants and gooseberries, sometimes causing the leaves to turn yellow and thus indicating their appearance. The stem that is infested dies, and should be cut out as soon as the yellow leaves indicate its condition, or as soon as it can be found and burned while the pests yet inhabit it, in order to destroy them before they escape.

GRAPE.

Anthracnose or Bird's-Eye Rot: This is a Brown Rot, or what might be called Cancer, that appears on the fruit in the form of round spots somewhat resembling the eye of a bird,—hence the

second common name. The proper treatment is to spray or wash the vines, posts and trellises with Sulphate of Iron and Sulfuric Acid, or Copper Sulphate, in water, one pound in ten gallons of water, while the vines are dormant, preferably before the buds open in the spring and repeat this three or four days later, but do not apply it so strong after the buds burst or the leaves appear. Spray occasionally with the Bordeaux Mixture after the blossoms drop.

Black Rot: This is a disease of grapes that causes the fruit to turn black, decay, shrivel and remain on the vines. It is easy to prevent it by spraying with the Bordeaux Mixture about the time the buds are bursting, and repeating this once every two weeks until after the fruit is half grown. Avoid spraying while the vines are in bloom. After the fruit is half grown use Copper Carbonate and Ammonia, which is the Cupram solution, repeating this every week or two if any signs of rot are to be seen. It is also advisable to pick off and burn all rotting grapes as soon as they are seen, and especially avoid leaving bunches hanging on the vines when rot is in them.

Downy Mildew: This is a disease making the leaves look as though dusted with a substance like fine down. Sulfur or Sulfur Compounds are specifics. (See Downy Mildew of Cucumber.)

Grape Vine Leaf Hopper: This is a small insect not one-fourth inch in length, belonging to the suborder Homoptera of the order Hemiptera, or True Bugs, discussed in a previous Bulletin. It has a piercing and suctorial mouth, and consequently does not eat away the tissue of the plant, but sucks the juices and injects a poison. Owing to their immense numbers they cause considerable damage. The eggs are laid on the under sides of the leaves. The young there hatch and first look like small plant lice, but are active and run quickly. The white cast skins remain clinging in numbers to the under sides of the leaves. When young they do not have wings. and consequently do not fly, and can not escape the insecticides applied as sprays. When full grown they are winged and jump and fly quickly and may escape the spray. The same remedies are to be used for these that are recommended for plant lice. For the winged or mature insects, it is a good plan to spray with five per cent. Kerosene Emulsion, which will force them to go to the ground, where they try to rub the liquid off their wings. Then immediately spray again with either a fifteen per cent. Kerosene Emulsion or Mixture or with Whale Oil Soap, one pound in four gallons of water, or some other strong soap solution. While these stronger sprays would be liable to injure the leaves of the grape vines, they can be applied to the insects on the ground without danger to the plants and with certainty of killing the pests.

For spraying the young insects,up-turned nozzles should be used, and care should be taken to reach them on the under sides of the leaves. As they are entirely suctorial in their feeding, poisons are of no use against them.

Powdery Mildew: This is another Mildew disease which appears as fine white grains rather than as small threads and more closely resembles flour dust. The treatment is the same as for the Downy Mildew.

Grape Root Worm: This insect takes its name from the fact that it feeds on the roots of grapes in its larval stage and is very destructive in that form and situation. In its adult stage it is a dark beetle called the "Steely Bug," which is probably so called from the metallic lustre of its wings.

It passes the winter in the ground, and comes forth as an adult beetle in the spring, feeding on the leaves for a short time before laying its eggs, from which hatch the larvæ or worms that feed on the roots. Watching for the adult beetles in the spring and as soon as they appear spraying with the Bordeaux Mixture and Arsenate of Lead, using about two or three pounds of the latter to fifty gallons of the former, is recommended. Where there are but very few vines, hand picking or jarring while it is quite cold in the morning is advisable. After the worm starts to feed on the roots of the vines it can be killed by injecting Carbon Bisulphide into the soil around them. Make holes six or eight inches in depth and two or three feet apart and pour from one-fourth to one-half teaspoonful of Carbon Bisulphide into each hole and close it with earth. Cultivate the soil frequently, especially just after the larvæ transform into pupæ or go into the resting stage.

Grape-vine Flea Beetle: This is a small beetle of dark color, not much larger than a common house fly, which jumps like a flea and is given this common name in consequence. It is not so easily killed as the Grape-vine Leaf Hopper, because it is a beetle or hard-shelled insect, and is less readily affected by contact sprays. However, it is a sucking insect and can be killed with arsenical poisons. It is partially prevented or repelled by the use of Bordeaux Mixture alone, and this spray can consequently be used at a time when the fruit is so far developed that poisons would not be advisable. However, at other times it would be best to add Arsenate of Lead, two or three pounds to fifty gallons of the Bordeaux Mixture.

The Rose Bug: This common and familar insect attacks a great many cultivated plants, trees and bushes by devouring the foliage when in the adult stage. It is not a bug but a beetle, as it has chewing mouth parts and eats the tissue of the leaves, making them appear to be perforated with numerous holes with quite irregular

edges. The larvæ of this bettle live in the ground and there transform to the pupal or resting stage and remain over winter. Deep cultivation of the soil near the roots of rose bushes and other plants they infest is advisable. Growers should watch for the first coming of these beetles in the spring, and jar them from the vine on sheets saturated with oil on the ground or held to catch the pests, or into a hopper cloth bug catcher, or should pick them by hand, or shake them from the vines and spray them with pure Kerosene or exceedingly strong soap solution while they are on the ground, where the leaves and plants will not be injured by the strong spray. Where a person is growing but a few grapes it is advisable to cover them with paper bags as soon as possible after blooming and setting of the fruit.

HOUSE PLANTS.

Aphids or Plant Lice: These are similar in appearance to the Aphids and Plant Lice described under "Apple," and the same remedies are to be recommended, with the additional directions to destroy them by holding the infested plants for a few seconds in the steam from a kettle, at such distance from the mouth of the spout as would be the extreme heat that can be borne by the hand held in it for the same length of time, or they can be destroyed by immersing the plants in hot water as hot as the hand can possibly bear for the same length of time.

Earth Worms: It is not generally known that Earth Worms or Angle Worms sometimes called "Night Crawlers" are injurious to the roots of vegetation by eating them, and even to young and tender garden plants and others by cutting them off at night and drawing them down into the holes. The work of the Earth Worm differs from that of the Cutworm in the fact that the former makes a long deep hole and during the day time retreats to the depth of the same and in feeding at night will often pull young plants and drag them into the holes if possible. We have actually seen onion sets in gardens pulled from the soil by Earth Worms. Their presence is indicated by the small pellets of finely ground worm-shaped castings of earth arranged in little mounds over their holes. To destroy them soak the ground abundantly with a very strong solution of lime water or with a weak solution of salt water.

Mealy Bugs: These are small pinkish to whitish insects which in appearance and habits may be said to be midway between Plant Lice and Scale Insects. They are partially covered and protected by a mealy or waxy secretion. They are especially bad on Coleus

plants and some other kinds. The treatment is the same as for Plant Lice, with the additional recommendation to touch them with a fine brush dipped into pure Kerosene.

Nematodes or Root Worms: These are not insects but very small white worms averaging smaller than a very small sewing needle. For potted plants, avoid fresh sod but use well rotted older earth for the purpose. Before using it, heat it three hours in an oven, or disinfect it by steaming. When the pests are present inject Carbon Bisulphide into the soil around the plants, or remove the plants from the infested soil, wash the roots in warm water, and replant in clean soil.

HOUSEHOLD PESTS.

Ants: These are too well known to demand description. Ants of three or four different species may cause trouble in the household. The best possible remedy is to trace them by the path in which they travel and find and destroy the nest. When the queen is killed the Ants will disappear. Do this by pouring into the nest a sufficient amount of Gasoline, Benzine or Kerosene. Be sure to reach the queen, or make a hole in the nest or as near it as possible with a sharp stick and pour in Carbon Bisulphide, and cover with a damp blanket to hold down the fumes. Methods of repelling Ants are discussed on page 48 of this Volume.

Bedbugs: These oval, flat, dark brown, foul-smelling and very offensive pests are too well known to need description. They often cause great annoyance, even in the bed rooms of the most thrifty and careful housekeepers. It is not at all necessary to suffer from the presence of such pests. There is nothing that is more easily, surely and effectively treated than pests in the rooms of houses. Fumigation with Hydrocyanic Acid Gas will do the work in a satisfactory manner. For each one hundred cubic feet of space one ounce of the Potassium Cyanide, two ounces of Sulfuric Acid and four ounces of water should be used. Before attempting to fumigate, the subject should be carefully studied, as the gas is a deadly poison to all animal life and human beings, and should not be used ignorantly. Write to this office for further information and for special Bulletin articles for which space in this particular Bulletin cannot be given. If for any reason fumingation is impractical, dissolve Corrosive Sublimate or Bicholoride of Mercury in alcohol and wash with this all places in which these undesirable pests can find concealment. Cracks of floors and walls and particularly their

hiding places in the beds should be thus treated. Do not keep this solution in metal or let it touch metal that is not to be corroded.

Buffalo Moth or Carpet Beetle: This insect in its larval stage is called the Buffalo Moth, perhaps because of the hairy and humped nature of the larva. It transforms into a pupa and from that stage into a small rounded, dark and slightly mottled beetle, about the size of a large radish seed. They are just small enough to be able to squeeze through the meshes of ordinary wire window screening. The damage is done in the larval stage, as these pests feed upon the wool or piling of carpets, making bare paths or spots. They are most destructive in spots where the carpet is less used, especially under furniture. They are to be killed by placing a damp towel on the carpet and ironing it with a hot flat iron to drive the steam down through the carpet, thus scalding them. Also, the edges of carpets and mats should be washed with Corrosive Sublimate dissolved in alcohol, and the carpets under furniture should be sprayed with an atomizer or small sprayer, applying this solution. Carpets and rugs should be frequently taken into the sunshine and open air and beaten vigorously. These pests can be killed by fumigation, as for Bedbugs and other household pests.

Clothes Moth: This is the insect which in its larval state makes a little tube from fibers of the material on which it feeds, and in which it finds concealment and protection. It destroys clothing or other articles made of animal material, such as wool, hair, feathers, fur, etc. It is inactive during the winter time in cold houses, but in houses heated by furnaces it may remain active and destructive all year. It transforms to a pupa within the case occupied by the larva, and from this comes the small winged moth which is light in color and has an expanse of wings of but little over one-fourth inch.

Methods of destroying or preventing them are fully discussed on page 48 of this Volume.

Fleas: These wingless but active, jumping insects are too well known to demand description. They do not originate independently as no insects generate in this manner. The adult or mature flea lays eggs, generally dropping them at night from the animals they infest, chiefly in the sleeping places of dogs and cats. We have seen great quantities of eggs of Fleas collected by placing a black cloth in the sleeping box of a house cat. From these minute white eggs hatch small larvæ, white in color, and resembling very small slender pointed wires. These feed upon organic substance in the cracks of floors and other places, transform there to pupæ, and further change to adult Fleas. This outline of the life history shows the reasons for advocating the eight different means of treatment for Fleas discussed on page 49 of this Volume.

Flies: These insects in the adult or winged state are well known, but their life history should be given. The House Fly is a type. The egg is laid in filth, mostly in or near stables. Within a few days the larva or maggot hatches therefrom and feeds upon the filth and grows until it reaches its full size, when it transforms into a brown pupa and remains inactive until it again changes to a winged insect. From this place of filth it flies and sooner or later reaches the household, where it not only causes great annoyance but often may introduce disease germs leading to serious results. With this knowledge a person can see the reason for advocating treatment given on page 49 of this Volume, including thorough and frequent cleaning of stables and such places, properly screening windows and doors, using sticky or poisoned fly papers, dusting with insect powder, and fumigating the rooms.

The Larder Beetle: This insect in its adult stage is fairly well known by persons who use dry preserved meat. It is a dark and gray mottled beetle, elongate oval in shape, and about three-eighths inch in length. It feeds on the meat and there lays its eggs, from which hatch larvæ that are covered with spiny hairs and may reach a length of nearly one-half inch before completing their growth and transforming into the pupæ. The larvæ are wrongly called "moths." The meat should be well brushed with a stiff brush to get rid of the pests in their various stages, and then enclosed in paper bags and tightly tied.

Mosquitoes: These common and troublesome pests also need no description in the stage in which we usually see them. Their life history, however, should be known in order properly to avoid them. The adult Mosquito lays its eggs in little rafts, which look like masses of soot, on quiet water. From these hatch the larvæ which are called "wrigglers" or "wriggle-tails," and live in water on the organic material there found. An ordinary rain water barrel will sustain enough wigglers to develop into Mosquitoes to give annoyance in several squares of a borough or village. An old vessel, such as a discarded tomato can, will support them in numbers. Care should be taken to avoid letting even small vessels of water stand open during the summer. In ponds or other places where the standing water is unavoidable the larvæ can be killed by putting oil of any kind on the surface of the water. Common lamp oil is effective. The remedies are discussed in the May Bulletin.

Roaches: Roach Bugs or Cock Roaches are the common, flat, reddish-brown, oval insects that are often seen in offices, pantries and kitchens, especially where much paste or flour is used. One species, which is most troublesome, is called the Croton Bug. They are sometimes destructive in libraries where they do damage by eating the glue from books or eating paper, card board or bindings

that have been glazed with paste or glue. They may also loosen wall paper by eating the paste from beneath it. They can be killed by placing a mixture of Plaster of Paris and powdered Sugar where they can eat it, or dusting abundantly with powdered borax, or spraying the cracks and places where they infest with the alcoholic solution of Corrosive Sublimate.

LAWN INSECTS.

Ants: See remedies for Ants under "Household Pests."

White Grubs: These are the larvæ of such insects as the May Beetles or June Bugs, the Bumble Flower Beetles, and some other beetles. They are commonly called Grub Worms. They may be quite destructive to the roots of vegetation planted where there is much organic material in the soil. They are worse where the old sod is turned down or where comparatively fresh manure has been used in abundance. The beetles lay their eggs in such places and the grubs there hatch, feed and grow. They may prove destructive to the roots or tubers of plants growing in the soil. We have observed the sudden wilting of melon vines in hills where manure was used, and have found this due to White Grubs eating off the roots. They may attack potatoes, corn and other plants, and sometimes are so destructive in grass roots as to destroy all the grass plants and leave spots brown and bare. They can be destroyed by injecting Carbon Bisulphide into the soil, as for the Grape Root Worm; also, let pigs root and eat them.

Cutworms: Described and discussed under "Corn" pests.

LIVESTOCK PESTS.

These are too well known to need description and the remedies are discussed on page 50 of this volume.

Bots: However, it should be more generally known that a disease known as Bots of horses is due to the larvæ of Flies of large size, which fix in the lining of the stomach, and may become so abundant and painful as to lead to fatal results. The Bot Fly lays its eggs on the hairs of the front legs, chest and neck of the horses, and these eggs remain as yellowish nits that are easily seen. The horses bite off and swallow the eggs, from which the larvæ hatch and live in the stomach and later are dropped on the stable floor. They transform into pupæ in the stable cleanings, and later change into the winged Bot Flies. This shows why the hairs containing the nits or eggs should be clipped from the horses whenever they are seen.

Bots in the head of a sheep, causing the so-called "blind staggers," are the larvæ of flies laid in the nostrils and developed within the head. This explains why the sheep should be salted in a trough in which the inner sides of the boards are smeared with tar, in order to prevent the Bot Flies from laying their eggs in the nostrils, which will become more or less covered with the tar from the trough.

PEA.

The Pea Louse or Aphis: This is a plant louse so closely resembling other Aphids or Plant Lice that the general descriptions given for the same group infesting Apple will enable pea growers to recognize this insect, as indicated by the name "Pea Louse." Remedies are given on page 51 of this volume.

Caterpillars or Leaf-eating Insects: Whatever species of insect may be found eating the leaves of plants can be destroyed by spraying with arsenites, such as Arsenate of Lead. This is to be preferred, because it can be used in greater and consequently stronger quantity without injury to the foliage, and also because it sticks better to the leaves than does Paris Green. Paris Green is next in order of material to recommend.

Mildew: Mildew is a well known disease of peas, and is discussed under "Mildew" of Beans.

Weevil: The Pea Weevil in its adult stage is a beetle somewhat resembling the Bean Weevil, but differing chiefly in size. Of course, there are other differences, one of which is that only one Pea Weevil is found in each pea, while several of the Bean Weevils may inhabit each seed. They excavate the interior of the Peas and make the round holes so familiar in these seeds. They should be killed either by fumigation, or by heating the peas to 150 deg. Fahr., for ten minutes after gathering, and also before planting, or by soaking the peas one-half hour in water as hot as the hand can be dipped into.

PEACH, PRUNE AND NECTARINE.

Borer of Peach: This destructive insect does its work entirely in the larval state, and is chiefly seen in that stage. It is then recognized as a white "grub" worm or larvæ living beneath the bark of peach, plum, prune and nectarine, and properly called "The Peach Tree Borer." It generally feeds beneath the surface of the ground, causing great masses of gum to form around the base of the infested

tree. Gum will form from other causes, but the presence of the Borer can be recognized by small brown objects like brown grains of sawdust in the gum which comes from its holes. It comes from an egg which is laid at the base of the tree by a clear-winged moth during July or August, and which commences to eat at the outside of the bark and soon cuts its way to the interior where it grows and remains as a larva during the winter and spring. About the first of June it transforms to a pupa within that a cocoon is covered with grains of sand or small particles of earth, and consequently looks like an oblong lump of earth, about an inch in length. From the latter part of June and later the beautiful, brightly colored. quick-flying, winged moths emerge from these cocoons. In flying by day and in quick, rapid, darting flight they resemble large wasps more than moths. Treatment is discussed on page 52.

Black Peach Aphis: Similar to the Aphis of Cherry previously discussed.

Brown Rot: The Brown Rot or Ripe Rot of peach and plum is a disease that causes the fruit to rot and turn brown about the time it is commencing to ripen. It is often designated in literature as Monilia. The fruit thus infected often remains on the trees, shrivels and becomes the "mummies" that are so frequently seen on peach and plum trees in the fall, winter and spring. The rot germs are spores which are to be seen in immense numbers as a white powder on the decaying fruit, and which can be blown from the fruit, looking like puffs of dust. It is very important to destroy all remains from the orchard of decayed fruit as soon as possible and spray with fungicides to prevent rotting. Recent experiments show that the best insecticide for the Brown Rot is either the Lime-sulphur Wash, made by putting Flowers of Sulphur on unslaked Lime and slaking the Lime by boiling with fire, using almost the same formula as for the San José Scale, but diluting with more water, to avoid injury to the leaves, or use a good commercial Lime-sulphur Wash, such as is made by the Niagara Spray Co., Middleport, N. Y., and called the "Niagara Spray." Dilute it two or three times the strength recommended for the San José Scale, with a few pounds of free or undissolved Flowers of Sulphur added. One of the best means of preventing Brown Rot is to avoid planting the early varieties, which are more susceptible to Rot, and keep the trees well pruned, in order to avoid much shade and dampness.

Curculio: See discussion under "Plum."

Little Peaches: This is the name of a disease which appears to have originated in some of the Northern States, perhaps Michigan, and is gradually becoming more extended over the peach growing portions of America. From one or two places it has been definitely reported in Pennsylvania, and also from some of the States south-

ward. The nature of the disease is not well known, but it results in the peaches remaining small and hard and not becoming fit for fruit. It is recommended to prune and burn the trees infected with this peculiar condition. We should like to have reports and specimens from trees supposed to be infected. It is essential to locate such diseases as rapidly as they appear in this State.

Shot-hole Borers: This is the insect that causes very small holes of uniform size about the size of a No. 6 grain of shot, often very close together in the bark of the trunks and branches of nearly all kinds of fruit trees and many shade and forest trees. Of course, the name is given from the fact that the hole made by the beetle in escaping from the place where it lived and fed as a larva, beneath the bark, looks very much like a puncture from a charge of shot from a shotgun. The holes from these beetles are seen only in trees that are dead or dying, and it is evident that they attack trees only when their condition runs low and they are ready to die. However, the Shot-hole Borer hastens their death and in some cases may attack certain branches while others may not be injured at the time. There is no known remedy after these pests have entered the trees, but when evidence of their presence is to be seen infested branches or trees should be cut and burned to prevent the spread of the pests to other trees. Severe pruning, spraying with the boiled Lime-sulphur Wash, fertilizing and cultivating, to increase the vitality of the tree will do a great deal to help in preventing loss by such pests.

Peach Leaf Curl: This is a fungous disease of the leaves, which makes itself manifest by causing them to become red and swollen, looking as though they had been blistered and stained red at the diseased part. The leaf becomes deformed and unnatural in appearance and, of course, is not able to perform its proper function in supporting the tree. Where Leaf Curl is abundant the fruit crop may be lost and further damage may follow by reduced vitality and failure to set strong fruit buds for the crop of the next year, as noticed by increased insect pests which are always ready to attack trees of lessened vigor. The Peach Leaf Curl is one of the easiest diseases to prevent. Spray with either the home-made boiled Lime-sulphur Wash or with a good commercial Lime-sulphur Wash, like the Niagara Spray, before the buds burst and at the same time that the spraying should be done with the same material for San José Scale and other pests. After blossoms fall spray with Bordeaux made with three pounds of Bluestone and five pounds of Lime in fifty gallons of water. If the variety or vitality of the leaves be such as to appear injured in the least by this spray, reduce the Bluestone slightly for the next spraying. Repeat this in two weeks and again in a month from the time of the first Bordeaux Mixture spray, as for fungous diseases of other plants. If the boiled Lime-

sulphur Spraying be thoroughly done before the buds burst, no other treatment will be necessary for Peach Leaf Curl that season, as the disease will not appear.

San Jose Scale: See discussion under "Apple." For Peach and Plum the oil sprays especially are to be avoided, and the boiled Lime-sulphur Washes are particularly recommended.

Yellows: This is the worst enemy of the peach and plum with which we must contend. There is a law against keeping trees infected with it, and this should be enforced. It is readily contagious and no remedy is known for it. The first evidence is shown in prematurely ripening fruits, through which streaks of red may be seen. The next stage shows in the leaves as smaller yellowish leaves, and next as small tufts of twigs, bearing yellowish diminutive leaves, and later and finally as great bunches of fine twigs with only very small yellow leaves, no fruit, and dying trees. Pull and burn trees as soon as they can be found infected and avoid dragging them through the orchard in such a way that any part will remain there or come in contact with healthy trees. Also do not leave infected trees or stumps in peach orchards that are to be cultivated, lest portions of twigs or roots should be carried by the harrow or cultivator and infect other trees.

PEAR.

Borers: The Borers of the pear trees are the Round-headed and Flat-headed borers of apple. See descriptions under "Apple."

Blight: Pear blight, Fire blight, Twig blight, Trunk blight, Body blight and Black blight are different names for the same disease. It causes the leaves to turn black and remain dry upon the branches. Blighted twigs turn dark and shrivel and the blighted spots on the bark are conspicuous by appearing dead, dry and shrunken. Pear blight is due to a bacterial disease. It is carried from tree to tree by birds, insects and other means, such as apparatus and pruning knife. To prevent this in trimming trees with the Blight the knife blade should be sterilized occasionally by dipping it into Bordeaux mixture, or a solution of Lime-sulphur wash, or turpentine. Do this frequently while pruning the trees or before passing from branch to branch. Since the blight is a disease under the bark it cannot be reached by any spray. There is no remedy known for it. A preventive is to cut off and burn the blighted branches as soon as they are seen and cut out and burn the blighted parts. Wash the cut surface with paint, boiled Lime-sulphur wash or tur-

pentine as a disinfectant. Be sure to cut the branches at least a foot below the diseased spot. Do not cultivate blighting trees, and retard the growth of the tree by not using manure or nitrogen fertilizer, as the blight is less on trees that grow slowly. Do not plant pear trees in rich or damp soil where they will have rapid growth.

Leaf Blight, Fruit Spot or Fruit Crack: These are different names for the same disease. The description and discussion is found on page 52.

Leaf Mite, or Pear Leaf Blister Mite: This mite causes brown blisters in the leaves of the pear and apple and also affects the fruit. Leaves that have spots looking like brown downy blotches on the under side should be sent to us in order that we may examine them and locate the regions where this pest is to be found. This was illustrated in our Bulletin August 1, 1907, Plate XIV. Burn the fallen leaves and apply the remedies mentioned on page 52.

Pear Psylla: The Pyslla is called the jumping plant louse because it is very much like a gray plant louse, but also jumps and flies. It looks very much like a small Cicada, and was described and illustrated in our Bulletin on the Homoptera. As it is a suctorial insect it does not eat the tissues of the plant, but injures the leaves by piercing them, injecting a poisonous saliva and sucking the sap. It is specially liable to be seen on the fruit stems and the leaf petioles or stem. The adult passes the winter in the mature or winged stage on the trunks of the trees under the scales of bark. The young are wingless and are similar in appearance to plant lice. They are to be destroyed by the remedies advocated for plant lice. This is discussed in our June Bulletin, page 51.

San Jose Scale: Described and discussed under "Apple." The same treatment is recommended for pear, excepting that pure crude petroleum can be used on pear without disastrous results which may result on other trees. Fifty per cent. mixture of petroleum will kill the scale without apparently damaging the pear trees. However, on this, the hardiest of our fruit trees, and especially on all more delicate fruit trees we recommend the home-made Lime-sulphur Wash or the Commercial solution such as the Niagara spray, made at Middleport, N. Y., and ready to be diluted with water and sprayed without straining.

Scab: See the description and treatment of Apple scab.

Slug: See description of slugs on cherry leaves. While the species is different the remedies are identical.

PLUM.

Black Knot: The Black Knot is a fungous disease of the plum and sour cherry which causes small or larger black knots on the branches. It may become so abundant on the trees as to result in their destruction. The knots deform the branches and cause loss of vitality and no fruit. Cut out and burn. See description and remedies on page 52.

Borers: The description and treatment are the same as for borers in peach.

Brown Rot or Ripe Rot: The description and remedies are the same as for this disease in Peach.

Curculios: There are two species of curculio attacking the plum. One is larger than the other, but their effects, habits and remedies are practically the same. Curculios also attack the apple, peach, cherry and quince and sometimes other fruit. They are snout beetles, mostly about ¼ inch long, and of a dark brown or gray color. They closely resemble the color of the bark of the tree, and are rarely to be seen except by spreading a cloth beneath the trees and shaking the branches, from which the beetles will fall. In the spring of the year they come from the ground, where they have passed the winter and commence to feed on the leaves and young fruit. Shortly after the blossoms fall they cut a crescent or small segment of a circle in the skin of the fruit, and when they are ready to deposit their eggs they put these through small holes made in the skin within the curve of the crescent-shaped cut. As these eggs hatch the larvæ bore into the fruit and devour it near the seed, causing the familiar "wormy" fruit. Their presence can be detected by the crescent cut, and by the hole put through the flap of such cut. The remedies are discussed on page 53 of the June Bulletin, 1907.

Lecanium or Plum Scale: A common scale of plum and peach is known by the different names, Turtle Shell, Terrapin Scale, and Lecanium. There are several species of Lecanium, but the appearance, habits and remedies are practically the same. They are almost exactly hemispherical in shape, being conspicuously raised lumps or elevations sometimes reaching a size equal to about the half of a small cherry seed. The young or undeveloped scales are to be found on the branches in the winter time, while the larger or fully developed females are to be seen during the summer. They are the largest scale insects to be found on any of our trees, and are easily recognized. They should be treated by remedies discussed on page 52 of this volume.

Leaf Blight, Shot-hole Fungus, etc.: There are many different fungus diseases that may attack fruit trees. The Shot-hole fungus

is one that receives its name from the fact that it makes holes in the leaves of the trees, very much as though they had been perforated by shot. All leaf diseases should be treated by Bordeaux mixture, or some other fungicide, as discussed on page 8 and 53.

POTATOES.

The Colorado Potato Beetle: The Colorada potato beetle is a large striped beetle which was introduced into this State about 1872, and occasionally becomes abundant and destructive in the potato fields. Its young are the familiar red and black larvæ seen on the stalks and leaves, while its eggs are deposited in the form of long slender yellow eggs arranged in an orange-colored mass. When these reach full growth they go into the ground and pupate and remain in such place during the winter. The potato beetles have many enemies, among which are their internal parasites, birds and poultry. It is the parasites which have caused them to drop out of sight occasionally and at other times to appear in greater numbers through the reduction of the parasites. There is no longer any trouble in preventing loss from the potato beetle. Spray with any Arsenical poison whenever the insects are seen. Arsenate of Lead and Paris Green are standards, with preference for the former because it sticks better.

Blister Beetle or "Old Fashioned Potato Beetle": The Blister beetles are very long, slender, dark brown or striped beetles, running quickly and reaching a length of fully an inch. Some of them are striped and some are plain black, gray or brown in color. The larvæ live in the soil feeding on soft insects which they are able to capture, and on the eggs of such insects as grasshoppers, and thus in this stage they do a great deal of good. The adults may feed on the leaves of almost any plant of the Nightshade Family. When they are so numerous as to demand suppression, effective work can be done by putting straw in rows between the vines and whipping the beetles into this with bunches of long switches, and setting the straw on fire. Those that are not burned will run or fly away.

Flea Beetles: While not the same species as the Flea Beetle of the Grape, they are similar in appearance, and the treatment is about the same. The Flea Beetles of the potato may be of two or three species, and are often so numerous as to cause the leaves to appear brown, as with blight. They feed upon the upper surface of the leaves, gnawing through to the under side but not eating through it, thus causing a number of little brown specks through which it is

possible for the germs of disease to enter. Spraying with Bordeaux mixture, with an arsenical poison added, gives good results as preventive, repellant and remedy.

Grub Worm or White Grub: See discussion of this subject under Lawn pests.

Potato Rot: This condition is generally due to a disease known as late blight, or to certain climatic conditions such as hard rains and hot weather just before the ripening time. Mud packed firmly into the eyes, which are buds, smother them and may cause rot to ensue. This can not well be prevented, but the potatoes should be lifted and dried as soon as possible, kept cool, and stored in a cool dry place. Air-slaked lime can be put over them to absorb the extra moisture. They should be carefully sorted before storing to prevent the decayed tubers coming into contact with others. The regular Potato Rot, which comes only from the Late Blight, is simply the result of the disease germs working down the stem and into the tuber. To prevent it, spray as for preventing blight, and should the blight come now pull the vines and burn before the germ works down the stem.

Early Blight: This is a blight of the leaf which may come during June which causes the leaves to turn brown and die, but which does not result in the rotting of the tuber as it doesn't strike down the stem to that part. The remedy is discussed on page 54 of this volume (June, 1907).

Late Blight: This is a disease of the leaf and stem which causes them to turn black in July or August. A germ causes this condition, and also works down the stem into the tuber, finally causing rot. It is to be prevented by spraying with Bordeaux Mixture during the early part of July, and continuing until the end of the growing season, spraying at least once every two weeks, and repeating whenever the material is washed off by hard rains.

Mildew: The appearance and remedies are similar to the Mildew of Beans.

Scab: This is a fungous disease of the tuber which causes scabby spots to appear on the potatoes. This often looks as though it were done by a worm having taken a bite or two, here and there, over the tuber, and they are sometimes wrongly called "bug-eaten" tubers or potatoes. This condition is caused in one of three ways:

(a) Planting scabby seed potatoes;

(b) Planting potatoes in soil that is already infected;

(c) Using as a fertilizer stable manure which contains the germs of the Scab.

To prevent it potatoes should not be planted in ground where scabby potatoes had previously been grown, and all seed potatoes

should be soaked in Corrosive Sublimate or Formalin. We much prefer the Formalin and find it effective and satisfactory. Use one pint of Formalin in 15 gallons of water and soak the potatoes from 40 minutes to one hour. In our practical planting we have a series of barrels, one above the other, at such elevations that the liquid will run from one to another. It can be used over and over again as long as any of it is left.

Stalk Borer: The potato Stalk Borer is a serious pest, as it is an insect that feeds inside the stalks or vines. In fact, there are two species, one of which is the larva of a moth, reaching a length of nearly an inch, and being striped with light pink or white stripes extending lengthwise. The other is the larva of a Snout Beetle likewise boring in the stalk or vine. Their appearance is to be detected by the sickly or yellowish appearance of the leaves and vines. These vines should be cut, or pulled, and burned as soon as it is found they are infested. As these borers also infest the stalks of large weeds it is very important to keep the weeds well cleaned up around the premises where potatoes are planted. In the fall just as soon as the potatoes are raised, the vines should be gathered and burned. Where there have been many stalk borers at work the ground should be plowed and cultivated in the fall and cultivated again, with a spring tooth harrow as early as possible in spring, and again before planting.

QUINCE.

Borers: Same description and treatment as for borers of Apple.
Codling Moth: Same description and treatment as for Apple.
Curculio: Description and treatment given under Plum Curculio.
Blight: Description and treatment given under Pear.

ROSE.

Aphis or Plant Lice: See description and treatment of Aphis under Apple.

Black Spot: This is a fungous disease of the leaves which causes them to appear black in spots. It is to be prevented by occasionally spraying with a fungicide. Cupram is to be recommended for the reason that it is colorless and does not stain the leaves.

Leaf Hoppers: Description and treatment similar to those of Leaf Hoppers of Grape.

Rose Bug: See description and treatment under Grape.

Mildew: See description and treatment under Bean.

Red Spider: The Red Spider or Red Mite is not an insect but is really a kind of spider. In its structure it is in accord with the spiders rather than the insects. It is to be killed and prevented by spraying with something that contains sulphur. Sulphur is almost a specific or certain remedy for this particular pest. Where forceful jets of water can be used, as from a force pump or hydrant, it is well to wash or syringe the plants with water, and spray with Potasium Sulphide or Soda Sulphide, two ounces of either, dissolved in a gallon of water, or dust with sulphur while the leaves are damp, or spray with eight per cent. Kerosene Emulsion, with a handful of flowers of sulphur added, or with a soap solution and water, with sulphur added to the same.

Rust: The rust of roses, berry bushes and other plants is caused by a fungous disease making the leaves look red and rusty in appearance. Sometimes they appear quite red. It is to be treated by abundant spraying with Bordeaux and picking the diseased leaves and burning them. As fast as the individual leaves show the rust they should be picked and burned. Destroy all fallen diseased leaves. It is possible to spray with Cupram which is a colorless liquid and does not make a stain. Make the spraying as soon as the leaves open and once every two weeks after.

STRAWBERRIES.

Aphis or Plant Lice on the Roots: The root aphids which live in the soil, are often white in color, but sometimes they are greenish and sometimes bluish, and sometimes dark. If the strawberry plants are not doing well the roots should be examined for pests. If the aphids or plant lice be found present, fumigate by putting Carbon Bisulphide in holes in the soil around the roots, or mixing tobacco dust abundantly in the soil near them, or remove the plants from the soil entirely and fumigate with Hydro-cyanic acid gas, one ounce of Cyanide to 1,000 cubic feet of space, the same as for Greenhouse fumigation. The best plan is to be sure to set clean or uninfested plants in soil which did not grow strawberry or melon plants during the previous year. If it be impracticable to fumigate the plants before setting them out, dip the roots into a strong tobacco decoction or eight per cent. Kerosene Emulsion. Where strawberry vines are badly infested they should be plowed under and not replanted on that plot for at least one year. This soil can be planted in other crops, excepting melons.

Cut Worms: See description and discussion of Cut Worms under Corn.

Leaf Roller: This is a small insect larva which develops into a very small winged moth. The destruction is caused by the larva rolling the leaf into a tube, within which it lives, feeding on the foliage. The best remedy is to burn the leaves, the same as for leaf blight, as soon as the fruit is gathered.

Strawberry Leaf Blight: This is a fungus disease of strawberry leaves which causes them to blight and cause injury to the strength and vigor and fruitfulness of the plants. It is to be prevented by spraying before the blossoms come, with Bordeaux Mixture, and especially by mowing the leaves as soon as possible after the fruit is gathered, and drying them like hay in the sun, enough to be able to rake them together between the rows and burn them. This is a good treatment for all strawberry beds. If the leaves will not readily burn, put them on rows of straw placed between rows of plants. Burn when the wind will carry the fire lengthwise of the rows of straw and dry leaves.

Saw Fly: The description and remedy are similar to that of the Saw Fly on Currant.

Weevil: The strawberry Weevil is a snout beetle which punctures the fruit stalk. While no good remedy is known, it will be effective to pick off and burn the drooping vines or fruit stalks as soon as they are seen. Where it appears in a strawberry field it is advisable to avoid those plants that are purely staminate, or are "fertilizers," bearing no fruit.

TOBACCO.

Flea Beetle: See description and remedies under Grape.

Grass Hoppers: These insects are too familiar to need a lengthy description. They injure the leaves by eating holes in them, especially near grass fields. They are to be destroyed by arsenical sprays or by keeping turkeys to roam over the fields to feed on the grass hoppers.

Tobacco Worms: The chief Tobacco Worms are those that have a caudal spinal horn, and reach a large size, being nearly as large as a man's finger. The larva goes into the soil and transforms into a chrysalis with a long curved handle, which is really a sheath in which the mouth parts are contained. In this state they pass the winter in the ground, and come forth the next spring as quickly flying moths, that are to be seen in the evenings near tubular flowers, looking like humming birds, and are called "humming bird or hawk

moths." These in turn lay eggs on the tobacco, tomato and potato, and other plants of their botanical family, and from these the "worm" or larva hatches. They should be picked off by hand, or sprayed with an Arsenical poison while the plants are young. Paris Green spraying is now common and successful for these.

Tobacco Seed-Pod Worm: This insect is a moth of a beautiful mottled green color, wings nearly one inch in expanse, which has lately come into this State from the South. The eggs are laid in the summer on the seed capsules, and the larvæ bore into the capsules and feed on the numerous seeds, thus destroying the seeds that might be saved for planting. Whenever they are found they should be picked off and burned or crushed. If there is much infestation the entire tops should be cut off and burned and seed procured elsewhere rather than continue to run the risk of destruction by this pest, by growing seed pods for it to infest that year.

TOMATO.

Cut Worm: See description under Corn.
Tomato Fruit Worm or Boll Worm: See description under Corn.
Flea Beetle: See description of Flea Beetle under Grape.
Totato Worm: See Tobacco Worm.

WHEAT.

Hessian Fly: The damage is done by this insect in the fall or spring, when it is in its larval stage. It is the larva of a small fly which in a great portion of this state has two broods per year. The eggs are laid generally during the last week in August and the first three weeks in September. To avoid this loss, wheat planting should be delayed until after the 20th of September, and in the southern and southeastern portions of the State it should be even later.

The Hessian fly in its larval stage is a white maggot, feeding beneath the sheath of the leaf at the base of the stalk, sucking the juice of the plant, and resulting in its death, or stunting the growth of the plant and causing it, at that time, to have a bushy appearance. Such plants may not survive the winter. Description and remedies are given on page 56.

Smut: Smut is a fungous disease causing black heads of wheat and oats, and considerable loss. It can be prevented without any trouble by treating the seed before planting, by soaking one-half

hour in a solution of Formalin or Corrosive Sublimate, the same as recommended for treating potatoes before planting.

Wheat Head Army Worm: This is a dark, somewhat striped insect larva which reaches a length of about one inch, and may march as an army if it becomes sufficiently numerous to destroy all its food, which causes it to march by reason of hunger, or it may remain in a field and damage the wheat heads at the time they reach the milky stage. Remedies are given on page 56.

Persons not having a copy of the June Bulletin frequently cited above, can obtain it by writing for the same, to H. A. Surface, Economic Zoologist, Harrisburg, Pa.

AVOID CARBOLIC ACID TREATMENT.

During the months of March and April of this year an article was extensively circulated in some of the newspapers to the effect that Carbolic Acid could be used against scale insects and other pests of trees. This has caused so much trouble that we have been obliged to write many letters concerning it, and in order to set forth the facts of the case that the public may read and understand, we publish below the article and also our correspondence with a nurseryman and Dr. J. B. Smith, State Entomologist of New Jersey, upon this subject. We think this should be enough to convince readers that the Carbolic Acid treatment is not to be relied upon.

"CARBOLIC ACID USED TO FIGHT TREE PEST."

Montgomery County Farmers Interested in Experiments of Philadelphia Judge.

Results Encouraging.

North Wales, Pa., March 15.

Farmers interested in preserving their trees from the ravages of the San José Scale are watching with considerable interest the experiments with carbolic acid that are being conducted at several places in Gwynedd township, Montgomery county.

The havoc wrought by the scale is such that in some sections many of the fine old shade trees and orchards surrounding the residences of wealthy Philadelphians are in danger of complete destruction. The labor and time necessary to thoroughly spray a large number

of trees is quite an item to the busy farmer, but many believe that through the acid treatment there is a way of completely destroying the pest at a very slight cost.

Judge William H. Staake, of Philadelphia, whose summer residence and farm are situated near the Friends' Meeting House, Gwynedd, is the first one here to use a 25 to 30 per cent. solution of carbolic acid in his fight against the scale. Judge Staake has sent to a local paper the result of the experiences of a friend near Lambertville, N. J., where the acid has been used for several years with such good effect that the scale has disappeared entirely from every tree on the place.

The acid was first applied by painting a band about eighteen inches wide around the trunk of all the trees, and practically all the scale was killed. The next year the trees were painted from the ground up to the limbs with a 50 to 60 per cent. solution of second quality carbolic acid, and the scale disappeared entirely, and that year over 4,000 bushels of fine apples were gathered from a sixteen-acre orchard, which the year before had borne no crop worth speaking of.

The experiments have shown that the best time to apply the acid is when the sap is running, as the sap neutralizes the effect of the acid. The rough bark is first scraped off and the acid applied with a paint brush from the ground up to the limbs, and, if the scale is very bad, up the limbs of the trees as far as possible. The same treatment has been applied to berry bushes of all kinds with good results.

The following is a letter I received from a nurseryman in Pennsylvania:

Hoyt, Pa., March 16, 1908.

Mr. H. A. Surface, Harrisburg, Pa:

Dear Sir:—I am enclosing letter sent to Judge S——— and later turned over to Mr. C. F. G———, of Hoyt. Mr. G——— mailed the letter to me and asked me what I thought of the same. There are several persons in this section, friends of Judge S———, that have already purchased the Carbolic Acid, as I saw two shipments at the depot this morning. I would like to have your opinion of same and expect to try it on two trees badly infested with scale on the G——'s place. If it is as good as Mr. T——— says, it will be a good thing for everybody to know. An early reply will be greatly appreciated.

Yours truly,

F. S.

The following is our reply to the above letter:

March 17, 1908.

Mr. F. S., Hoyt, Pa.:

My dear Mr. S.:—Replying to your letter of the 16th, asking about the use of 50 per cent. Carbolic Acid painted on trees from the ground to the lower limbs for scale insects, I beg to say that this is to be a re-hatching of an old and exploded notion. It is a very decided error. There is no doubt in my mind of the certainty or truth of this statement. In the first place, such material painted on the bark will not be taken up in the sap, and in the second place if it should be so absorbed and carried up into the trees, anything that would be strong enough to kill the scale and other insects, would also kill the tree, and its application would thus be worse than useless. The great difficulty appears to be that persons who have trees do not know for certain when the scale is dead and when it is not, and they pronounce in favor of it when they really do not know the evil results for themselves. I would by no means recommend the use of such a thing as Carbolic Acid either as a spray or wash for scale insects. There is nothing known that will kill the pests on the branches of trees without coming into actual contact or touch with them. If the Acid of the strength advocated come into contact with the buds, it might kill them.

The more I see in this State and the more reports I receive from my inspectors in the various parts of the State, the more fully am I convinced that there is nothing to equal the Lime-sulfur Wash as an effective and cheap insecticide for the scale and other insect pests, and also as a fungicide. I have hundreds of letters to testify to this important fact. If you do not wish to go to the trouble of making the boiled Lime-sulfur Wash, you can use the commercial material, if you will buy the right kind. I have tested the Niagara Lime-sulfur Spray, made by the Niagara Spray Co., of Middleport, N. Y., and have found it to give excellent results. This is sold by the barrel in a concentrated form and can be diluted with ten or twelve times the amount of water and will act as a fungicide and insecticide, when merely dilute with cold water. This is to be recommended as it is a most satisfactory commercial insecticide in case you do not wish to make the home-boiled Lime-sulfur Wash. I would advise that you try some on your trees beside those on which you try the Carbolic Acid treatment. Do a thorough job with each material and note the results in a year or two from now. The letter to Judge S——— is herewith returned.

Very truly yours,

H. A. SURFACE, Economic Zoologist.

DENIAL OF CARBOLIC ACID TREATMENT FOR SCALE.

The following is our correspondence with Dr. John B. Smith, State Entomologist of New Jersey, on this subject:

March 17, 1908.

Dr. J. B. Smith,
New Brunswick, N. J.

My dear Doctor Smith: I have a letter from a man in Philadelphia concerning a trip that he took to the farm of Mr. Thatcher, some distance above Flemington, N. J., for the purpose of seeing the results of painting various trees and bushes near the ground, with a thirty per cent. aqueous solution of carbolic acid for the San José Scale. He claims that he has cleaned the trees of bad infestation, and adds "The New Jersey State Experiment Station has been making an investigation; the first year they laughed at the idea and its folly, last year they had men there nearly the whole year, and the Chief of the Bureau stated that he took off his hat and bowed to the success of Mr. Thatcher's treatment, and this recommends it for general use as the only method to combat the pest."

I write to ask if you will kindly give me information concerning this. I had heard of the proposed carbolic acid treatment, but have not learned that you so fully endorsed it. I shall thank you for light on an interesting subject.

Very truly yours,

H. A. SURFACE.

Prof. H. A. Surface,
Dept. of Agric.,
Harrisburg, Pa.

New Brunswick, N. J., March 19, 1908.

Dear Prof. Surface:—Yours of the 17th inst., is at hand. I have seen that letter and it is a mass of misstatements from one end of it to the other. Some reference to the work done by Mr. Thatcher is in my Report for 1906, which of course you have, and a more full report of what was done and what inspections were made appears in the Report for 1907, which is just off the press, and a copy of which I am sending you, under separate cover, by same mail. A number of people who have used this carbolic acid banding claim success for it; but in almost every instance there is an explanation other than the banding for the comparative freedom of trees from

scale and nothing is further from the truth than the statement that there were no live scales on Mr. Thatcher's apple trees.

Very truly yours,

JOHN B. SMITH.

March 23, 1908.

Dr. John B. Smith,
New Jersey Agricultural Experiment Station,
New Brunswick, N. J.

Dear Doctor Smith: I desire to thank you for your favor of the 19th, giving me information that the article on the use of Carbolic Acid for Tree Pests is a fake and a mass of misstatements. By this morning's mail I have received no less than five or six letters containing the enclosed clipping, and asking me about it. It evidently will do much damage in this State and New Jersey by inducing the people to use it instead of a spray of proper material for the scale. I, of course, did not believe the statements there made, but when they plainly brought out your name in the article, I thought there might be something that we had not previously realized.

Very truly yours,

H. A. SURFACE.

Prof. H. A. Surface,
Dept. of Agric.,
Harrisburg, Pa.

New Brunswick, N. J., March 24, 1908.

Dear Prof. Surface:—Yours of the 23rd inst., with inclosure is at hand. This thing is making me a lot of trouble, and I suppose will continue to do so for some time to come until the newspaper articles are forgotten. I have not attempted to reply and will not, because that would only keep the subject alive. This carbolic acid thing is one that must run its course, and it will take two or three years before it completely dies out.

Very truly yours,

JOHN B. SMITH.

COMMERCIAL SPRAYERS.

The following is a list of names and addresses of persons who will furnish apparatus and do commercial spraying. If others are known we shall be glad to learn of them.

Bedford County.

Mr. Todder, Bedford.
Mr. L. O. Walter, New Enterprise, Pa.

Berks County.

Mr. Henry Miller, Shoemakersville, Pa.
Mr. W. P. Ruth, Sinking Springs, Pa.
Mr. J. S. A. Schaeffer, North Heidelberg, Pa.
Mr. J. H. Giles, 123 S. Fifth St., Reading, Pa.
Mr. W. K. Hummelreich, Blandon, Pa.
The Board of Poor Directors at Shillington have a Niagara outfit which they will rent.

Blair County.

Mr. N. A. Rhodes, Tyrone, Pa.

Bucks County.

Mr. H. L. Shelly, Quakertown, Pa. (50c per tree).
Mr. Jos. T. Diehl, Perkasie, Pa. R. No. 2.
Mr. E. H. Alderfer, Souderton, Pa. Bell 19W. 2 machines.
Mr. Charles Rickert, Perkasie, Pa.

Chester County.

Mr. Dennis Gallafher, Strafford, Pa.
Mr. J. D. Thomas, Whitford, Pa.
Mr. Chas. S. Coates, Nottingham, Pa.
Mr. J. T. Clarke, West Chester, Pa.

Clinton County.

Mr. H. S. Bollinger, Lock Haven, Pa.

Cumberland County.

Mr. John Hale, New Cumberland, Pa.
Mr. Kast, Mechanicsburg, Pa.

Dauphin County.

Mr. J. R. Snavely, Harrisburg, Pa.
Mr. E. B. Mitchell, Harrisburg, Pa.
Mr. Roy P. Walter, Berrysburg, Pa.

Lackawanna County.

Mr. Clark, (Florist), Scranton, Pa.

Lancaster County.

Mr. Jacob Chambers, Lancaster, Pa. Care of Dr. S. T. Davis.
Mr. D. P. Bricker, Lititz, Pa.
Mr. A. F. Trout, Quarryville, Pa.
Mr. C. D. Herr, Cresswell, Pa.
Mr. G. B. O. Felty, Millersville, Pa.
Mr. B. F. Barr, Lancaster, Pa.
Mr. J. Wilmuth, 735 E. Orange St., Lancaster, Pa.
Mr. Menno E. Shirk, Stevens, Pa.
Mr. Moses Lapp, Gap, R. F. D. No. 2.
Mr. Harlan Gatchell, Peters Creek, Pa., R. F. D.
Mr. E. Eshleman, West Willow, Pa. R. No. 2.
Mr John H. Weaver, New Holland, Pa., R. F. D.
Mr. John Kensinger, Leola, Pa.
Mr. Wesley Brook Hart, Lititz, Pa.
Mr. John Reist, Mt. Joy, Pa.
Mr. Phares Martin, Reidenbaugh's Store, Pa.

Lycoming County.

Mr. Wolf, Williamsport, Pa.
Mr. Hamilton, Williamsport, Pa.

Monroe County.

Mr. Randall Bisbing, E. Stroudsburg, Pa.

Montgomery County.

Mr. D. M. Ellis, Bridgeport, Pa.
Mr. H. E. Wohlert, Bala., Pa.
Mr. John M. Markley, Lansdale, Pa., L. B. 245.
Mr. J. K. Schwenk, Providence Square, Pa.
Mr. W. E. Baker, Skippack, Pa.
Mr. Calvin Hart, Lafayette Hill, Pa.
Mr. C. K. Milford, 1041 Green St., Norristown, Pa.

Mr. John Mooney, Conshohocken, Pa.
Mr. G. L. Oddy, Centre Square, Pa.
Mr. Wm. Sturzwecher, Lansdale, Pa.
Mr. Peter Reilly, Rosemont, Pa.

Northampton County.

Mr. L. E. Graver, Easton, Pa., R. No. 1.
Mr. J. N. Hartzell, E. Bangor, R. F. D. No. 43, Pa.
Mr. Ervin S. Lambert, Easton, Pa., R. No. 4.

Northumberland County.

Mr. F. A. Newcomer, Milton, Pa.

Philadelphia County.

Mr. Herbert Inman, 2419 N. College Ave., Phila., Pa.

Schuylkill County.

Mr. Al. Kimmel, Orwigsburg, Pa.
Mr. J. L. Heine, Orwigsburg, Pa.
Chas. Diehl, Pottsgrove, Pa., R. F. D.

Snyder County.

Mr. W. H. Bingaman, Beavertown, Pa.
Mr. J. J. Tobias, Beavertown, Pa.

Union County.

Mr. H. A. Taylor, Mifflinburg, Pa.
Mr. Geo. Kunkel, Lewisburg, R. No. 1, Pa.

York County.

Mr. John O. Gardner, 25 E. King St., York, Pa.
Mr. Marion Thomas, Delta, Pa.
Mr. Howard Anderson, Stewartstown, Pa.
Mr. John H. Baird, Stewartstown, Pa., R, No. 1.
Mr. W. H. Gemmill, Woodbine, Pa., R. No. 3.
Mr. John F. Stern, Sunnyburn, Pa.
Mr. John H. Budd, York, Pa.
Mr. D. Barnett, Woodbine, Pa., R. F. D.
Mr. O. K. Burkins, Woodbine, Pa., R. F. D.

COMMERCIAL AND NEW INSECTICIDES.

At this time of year we are receiving so many inquiries concerning new insecticides and commercial preparations that we deem it our duty to give general information, and at the same time reduce our personal correspondence on these subjects by publishing a few words concerning them.

The homemade soluble oil has not proven as satisfactory as circulated reports indicated it to have been. We know not how the report became so extensively circulated to the effect that we were pleased with the results of the homemade soluble oil. The statement was that it was apparently as good as any of the commercial or soluble oils on the market, but this is not saying a great deal for it. However, if contrary to all recommendations and warnings from this office and the experience of numerous practical fruit growers, whom we can name, persons should yet insist on using the so-called soluble oil (either commercial or home-made), in preference to the more satisfactory and better Lime-sulfur Solution, they can make the oil for themselves according to the directions published in our March Bulletin, at less than half the cost of the commercial oils, which may have about the same virtue.

Regardless of what may be said by agents and manufacturers, the commercial oils do not contain fungicidal properties, and they are not of uniform composition. There is liable to be injury of serious nature resulting to the trees from their use. We have before us written communications from various persons whose trees have been killed by them. The chief preparation for censure and criticism, according to our observations and extensive correspondence, is the one sold under the name of "Target Brand" or "Target Brand Scale Destroyer." From the evidence now at hand, we feel it our duty to warn our citizens against depending upon this material. We have before us a letter from a man, stating that the makers of this stuff paid him five hundred dollars ($500.00) in payment for trees which he had killed with it, and from another man stating that it had been so disastrous in his region that the Company recognized its evil results and were so generous as to withdraw the claim for payment of the material that had resulted in the destruction of the trees, and from another person to the effect that fruit trees of different kinds in his large orchard had been killed by it, and he now is collecting evidence and material for a suit for payment for his trees by the Company, but the latter refuse this, further than to offer him

the original cost, which is only a few cents each, for fine bearing trees that were just coming into their prime when sprayed and killed by "Target Brand." We know where commercial sprayers have used this material, with such results that they have lost their patronage, and the trees remain badly infested with scale, or show signs of injury by the material. Such positive reports and results of personal observations are the basis of our statement that we should not use the "Target Brand" on trees that we wished to save, even though the material were donated and the freight charges paid.

The oil preparation next in line for complaint is the one sold as "Scalecide." We have seen many trees in the most deplorable condition from its use. It proves the truth of our statement that the danger line between killing the tree and failing to kill the insects is so close or narrow that we can not hope to keep within it by the use of oils. We have letters now before us, reporting very disastrous or unsatisfactory results from the use of this material, and in one county of this State, where it has been advertised and used most extensively, the agents themselves are acknowledging that it has proven unsuccessful in controlling the scale. We know one large Pennsylvania fruit grower, who is an agent for this material, who has taken the opportunity at Farmers' Institutes, where he was a speaker, to advertise it extensively; but at the same time, we know from personal examination that his orchard is most seriously infested with San José Scale, and annually is becoming worse instead of better, although he has been using this material. He does not appear to know or to recognize the actual results and their cause. If fruit growers will watch carefully, they will see that most of the recommendations of the soluble oils come from persons who are interested in returns from their sales.

Our inspectors are going through the State in a thorough manner, and they report to us that far more Lime-sulfur Wash is being used in spraying for scale insects than any other material, and in fact more than all other materials combined. Their reports also show that this is the material which is giving the most uniform satisfaction. The following letter to the Economic Zoologist, from Dr. J. D. Herr, one of our careful and capable inspectors, explains the situation concerning Commercial Oils and the Lime-sulphur Wash in Pennsylvania:

"These Adams county orchardists are gentlemen. They also appreciate our work and endorse your methods. In fact, you have many friends among them. I find that the only good results of spraying so far found here have been gotten from the use of the Lime-sulfur Wash. Many who have used 'Scalecide' are becoming

disgusted with it and will use Lime-sulfur this spring. Mr. B's experience, as he expressed it to me, is typical. 'After trying everything I got down to the Lime-sulfur Spray, which is the only thing that did any good, and I had a fine crop of clean apples last fall.' I know this reads like a testimonial of a patent medicine, but an examination of his orchards proved the truth of his words."

Likewise the orchard on Mr. D$: farm. This eight acre orchard has been sprayed for years with Crude Petroleum, Target Brand and Scaleside and a worse infested orchard is hard to find anywhere. Thus showing that the fight has been a losing game with oils."

The agents for oil preparations are making the claim that not more than one fruit grower in ten is using Lime-sulfur Wash, and not more than one in four of those that use it, is having success. Of course, this is the claim of an agent, and must be taken with due allowance. The fact is that a far greater percentage of successful results have been obtained by our fruit growers using Lime-sulfur Wash than by any other material, and it is with certainty destined to become the standard insecticide and fungicide for scale insects and certain other insects and certain plant diseases, such as Peach Leaf Curl, Mildew, etc. Some emphatic statements can be made for the Lime-sulfur Wash that can not be made for any of the oil preparations. Among these are the following:

1. It is the cheapest.

2. It is the most easily obtained wherever needed.

3. It is not destructive to trees, and in fact can not be used strong enough to injure the trees, bushes or vines when dormant.

4. It is a tonic and especially beneficial on some trees, such as peach and plum.

5. It is a fungicide and destroys disease germs as well as insects. One spraying, when dormant, as for scale insects, will prevent the appearance of Peach Leaf Curl during the next summer.

6. It will not be injured by freezing, as are the prepared oils.

7. It has had more extensive satisfactory use by practical fruit growers than has any other known insecticide and fungicide.

8. It is most generally or universally recommended by economic entomologists connected with the U. S. Government and with State Experiment Stations and State Departments.

The most promising sign of the times in insecticide and horticultural work is the immense number of firms very recently preparing and selling the Lime-sulfur Wash in commercial form. They appear just to be recognizing what we have published during the past five years, that this material can be made and kept until wanted and diluted and used with success. We do not understand why this has not been done before this time, but within the coming year there

will be floods of advertisements of no less than eight or ten firms preparing Commercial Lime-sulfur Washes. The explanation lies in the fact that they recognize that the oils can no longer combat in merits with the Lime-sulfur Wash, and hence they desire to put on the market that which is recognized, demanded and used, even though it come into competition with all their previously advertised materials.

It will be remembered that there was a kind of Lime-sulfur-soda Solution put on the market under the name of "Con-Sol," made by the company that is now making and selling the "Target Brand." We found it necessary to condemn "Con-Sol" for its inefficiency, and although it was very widely advertised and most extensively recommended, the manufacturers themselves in the course of time agreed with us as to its failure to meet the needs of fruit growers, and withdrew it from the market.

It is now impossible for us to attempt to answer the many inquiries as to which is the best of the numerous new Lime-sulfur Washes on the market, as we have not been able to test them all, and we would advise the public to go slow in giving extensive orders of some of those that have not been tested, or have not been used before the present season. However, one that we have tested, and recommend, and which has been used with decided satisfaction in previous seasons and other States, is the commercial Lime-sulfur Wash, known as Niagara Spray, made by the Niagara Spray Co., Middleport, N. Y. This is setam-boiled, under pressure, and is ready to add to a tank of cold water and proceed with the spraying operation, without straining or other trouble.

Another firm is now commencing to advertise a Lime-sulfur Wash, which they claim can be diluted with twenty parts of water. An analysis of this statement shows that they should have all the extracts or insecticidal and fungicidal material from at least nine pounds of Lime and six pounds of Sulfur condensed into one gallon of the liquid to dilute it this much and yet be effective. This is too evidently impossible for us once to consider any such proposition as a Lime-sulfur Wash that can be diluted with one to twenty and be effective. Fruit growers should be on their guard concerning misrepresentations, and may write us for advice on these points if they choose. We shall be pleased to give accurate and conscientious information.

COPIES OF CORRESPONDENCE.

The following letters and replies are taken verbatim from our correspondence, and are of such general interest to many readers as to justify publication in this Bulletin:

Washing Small Trees Instead of Spraying.

Prof. H. A. Surface, Harrisburg, Pa.:

Dear Sir: I have about 12 or 15 young trees (two years old), apple, cherry and plum. The apple trees are badly infested with San José Scale. It seems to me there should be some way to wash these small trees without mixing one of the formulæ which would make 100 times what would be needed. Would clear kerosene oil do?

Answer.

Replying to your inquiry of the 7th, asking if you can wash your small trees that are infested with San José Scale instead of spraying them, I beg to say that you can do so very successfully, and also at any time of year. When the trees are in leaf we can not spray with a material strong enough to kill the scale because of the danger of killing the leaves, but if we apply the Lime-Sulfur-Wash or other insecticide with a brush we can put it where it is wanted by taking care to avoid applying it to the green shoots or young leaves. Of course, it is necessary to cover all the infested twigs, but with a very small tree this can be done without great difficulty. It will surely kill the scale.

By no means should you use clear kerosene oil, as this will be practically certain to kill the trees. I must again emphasize the necessity of following the formula prescribed in bulletins upon this subject. You can use Whale Oil Soap, one pound in a gallon of water, or common laundry soap, or soft soap, two or three pounds in a gallon of water, if you keep the material off the leaves, but the standard material is, of course, the Lime-Sulfur-Wash, either home-made or the commercial article, such as the Niagara Spray, made by the Niagara Spray Co., at Middleport, N. Y. If you wish to make the Lime-Sulfur Wash for yourself, take the formula of seventeen pounds of sulfur and twenty-two pounds of lime and fifty gallons of water, and divide this by the same number. For example, if you wish only one-half gallon, which would perhaps be enough to paint two or three small trees, use 17-100 or about 1-5 f sulfur, and 22-100 or slightly more than 1-5 lb. of lime and

50-100 or ½ gal. water. Boil it an hour, in an old iron kettle, or any other vessel excepting copper. In the same way, find the proportion for any larger quantity that you would wish to use. A good general formula for a small amount of the Lime-Sulfur Wash is one pound of sulfur and one pound of lime, boiled in water for one hour, and water added to make three gallons when dilute. You can, of course, in applying it with a brush, make it two or three times this strong if you desire, and you need not go to the trouble of straining it. It will not injure the trees at any strength. In this regard it differs from the oils, which should never be used stronger than our regular prescribed formula.

For trees that can be reached with brushes I recommend washing after the leaves are too far out for spraying.

Maple Scale.

Hon. H. A. Surface, Harrisburg, Pa.:

Dear Sir: I take the liberty of sending you herewith a small branch from a maple tree infested with some parasite. This has been very prevalent on trees in town for a year or more and I would like to ask you what it is, and if it is likely to destroy the life of the trees, and what, if anything, will kill it.

If it menaces the life of the tree would the State send a competent person to spray the trees, if the owners would combine to pay the expense?

Answer.

Replying to your letter of the 2d, I beg to say that the maple branch which you sent to us was duly received and examined, and entered in our collection as No. 11,480. It proves to be infested with the Maple Turtle-shell, also sometimes called Terrapin Scale. This is one of the worst pests of maple, and is liable to result in serious injury to the tree, but fortunately it is held in check by parasites which in time develop and thrive inside the body of the scale insect and destroy it. However, it is not advisable to wait for the parasites to do their good work. If the trees be much infested, it is best to spray them as soon as possible with the boiled Lime-sulfur Wash. If you can not readily make your own material, according to the formula in our October Bulletin, I would recommend the commercial material made and sold by the Niagara Spray Co., of Middleport, N. Y. For this particular pest use it double strength, or in other words dilute one gallon of the commercial material with five gallons of water instead of ten, or dilute the

home-boiled formula (17 lbs. sulphur, 22 lbs. lime), with water to make 25 gals. after one hour's boiling. As this commercial material is liquid and needs nothing more than the addition of cold water to be prepared for spraying over the trees and kills the scale pests, and as it does not need to be strained, heated, or otherwise treated after you receive it, it appears to me that any person could spray successfully with it who would be able to procure a spray pump, and who would do a thorough job of spraying, covering the trees from all sides, from the tips of the most remote branches to the base of the trunk. If the wind be blowing they can be sprayed from one side only, and when the wind changes, or when it is calm, direct the spray from the other side.

Unfortunately, we have no person in this office who does commercial spraying. All of our men can do spraying and do this in a demonstration manner, or to show how spraying should be done, but we do not spray for pay, and we have no arrangements for this, and consequently can not undertake it. However, if some person in your region would at once get to work in this regard and let me know when you are ready to spray, I would be willing to send my nearest inspector to spend a few hours with him and get him properly started.

There is no time to lose in the treatment of this pest this spring before the buds burst, as it is practically impossible to spray successfully for it while the leaves are on the trees, and your next shot at it would be next fall as soon as the leaves drop.

How Late to Spray.

Dear Sir: Enclosed please find some peach twigs. Are the buds too far advanced to do any more spraying? I am only half done, but there is no scale on any of the trees. I use 17 lbs. sulfur, 22 lbs. lime, no salt, and 50 gallons of water.

Please let me know at once as I am waiting for a reply.

Answer.

Replying to your letter of the 3d, enclosing some peach twigs, and asking if buds are too far advanced to spray with the Lime-sulfur Wash, I beg to say they are not. It is my opinion that unless it should become very warm you can spray this spring until after the middle of April with safety, and with benefit to the trees. Perhaps you can spray even longer than that. My rule is to spray until the blossoms are just ready to open, and stop at that time. This means after the blossoms are seen but before they open.

Perhaps this may prove to be a day or two late, but I saw trees that were sprayed when in such condition of advancement, and they were not injured by the spray liquid, but the scale was killed and they bore good crops of fruit. These were peach trees, and we also sprayed both peach and apple last year when the leaves were nearly one-half inch in length, using the regular winter formula of the Lime-sulfur Wash, and killed the scale and did not injure the trees, although the tips of some of the leaves were scorched brown. I understand that you can obtain a commercial preparation sold as the Niagara Spray Solution. This is a concentrated Lime-sulfur Solution, made by the Niagara Spray Co., at Middleport, N. Y. I believe this is sold by some person in your region, and I recommend it as a good material in case you are now rushed for time and do not care to make your own Wash and need a material that must only be diluted with cold water and sprayed on the trees in a hurry without having to take the trouble of boiling or straining it. At this time of year every suggestion that will save time in doing spraying is worth many dollars to a man. I agree with you in the idea of spraying peach trees and also plum trees with the Lime-sulfur Wash whether they have scale or not. I have carefully examined your twigs for scale and find none upon them.

A CORRECTION.

On page 347 of the March Bulletin, Vol. V, No. 11, the Lime-sulfur formula was published as 22 lbs. lime and 17 of sulfur. These numbers should be reversed as a little more lime is recommended than sulfur, but satisfactory results would be obtained by using the formula as there given. The only objection would be a little increased cost by the use of sulfur than the less amount of lime would demand.

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